Building NOAA's Environmental Real-time Observation Network

Site Maintenance Plan
February 28, 2005

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service

Signature/Approval Page

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Site Maintenance Plan

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1 Introduction

These maintenance procedures are intended to ensure uniform station and sensor maintenance and to maximize safety, data quality, and equipment reliability across NOAA's Environmental Real-time Observation Network (NERON). The intent is to provide organizations contracted to maintain NERON stations with explicit and clear instructions about how the Integrated Surface Observing Systems Program Office (ISOS Office) at the National Weather Service expects the equipment and sensors to be maintained, reducing confusion and cost and resulting in a world-class climatological and meteorological observing network.

This document is formatted as a field reference manual that can be taken into the field by technicians. Page breaks have been inserted before all major sections and to separate procedures so that they can be located easily by scanning the headings at the tops of pages and so that the manual can be laid open to a single procedure at a time.

2 Station Configuration Figures

The figures on the following pages show how the three types of weather station (2-meter mast, 7-foot tower, and tall tower), in combination with the three plot sizes (10 ft. x 16 ft., 16 ft. x 20 ft., and 20 ft. x 40 ft.), are configured in NERON.

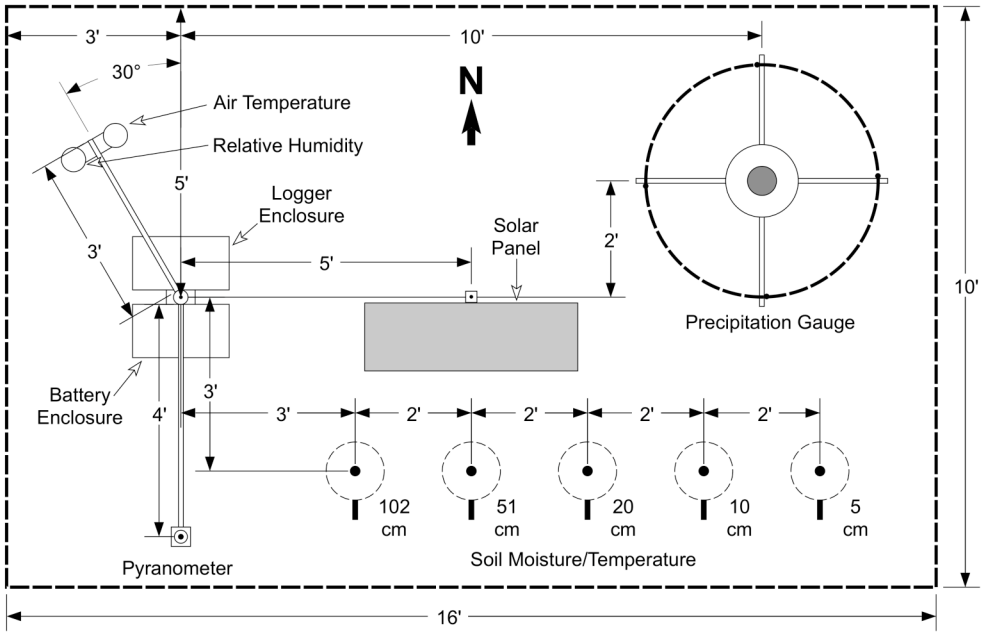


Figure 1. Plan view of a station plot that measures 10-by-16-feet.

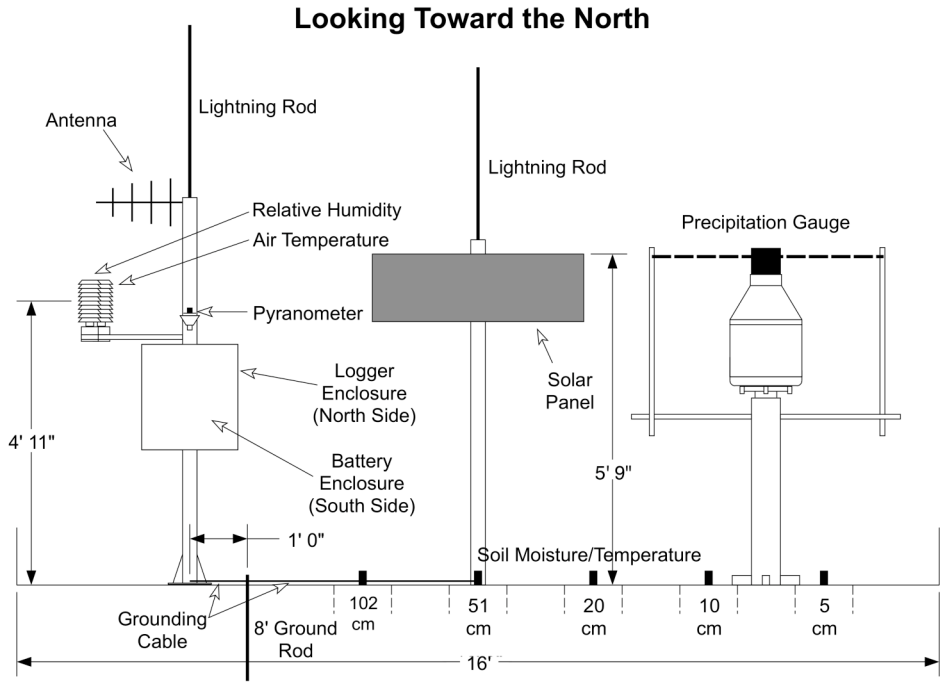


Figure 2. Profile view of a station plot that measures 10-by-16-feet.

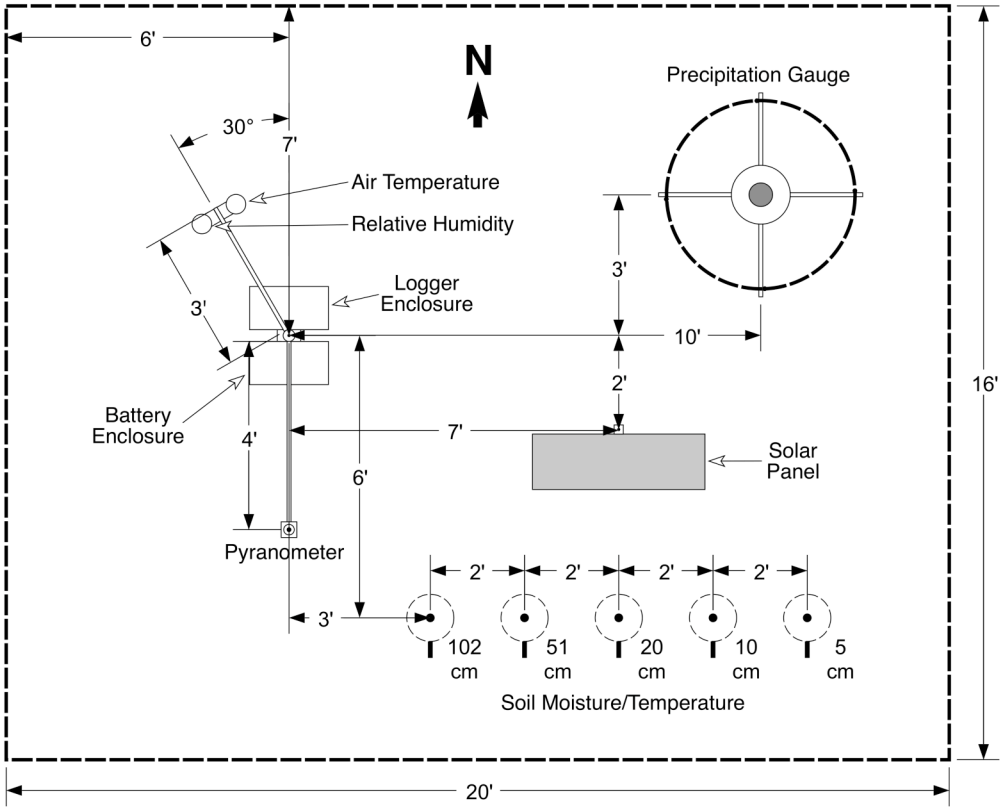


Figure 3. Plan view of a station plot that measures 16-by-20-feet.

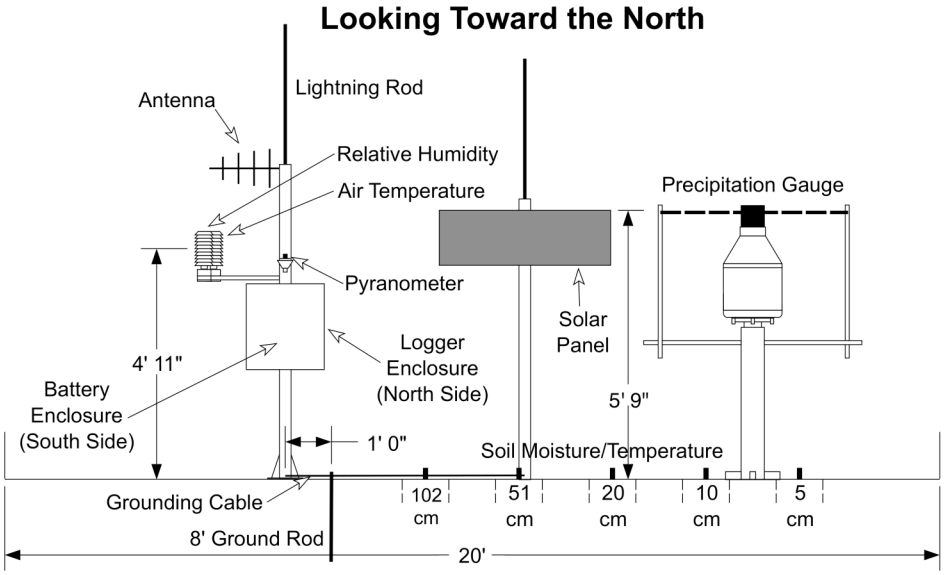


Figure 4. Profile view of a station plot that measures 16-by-20-feet.

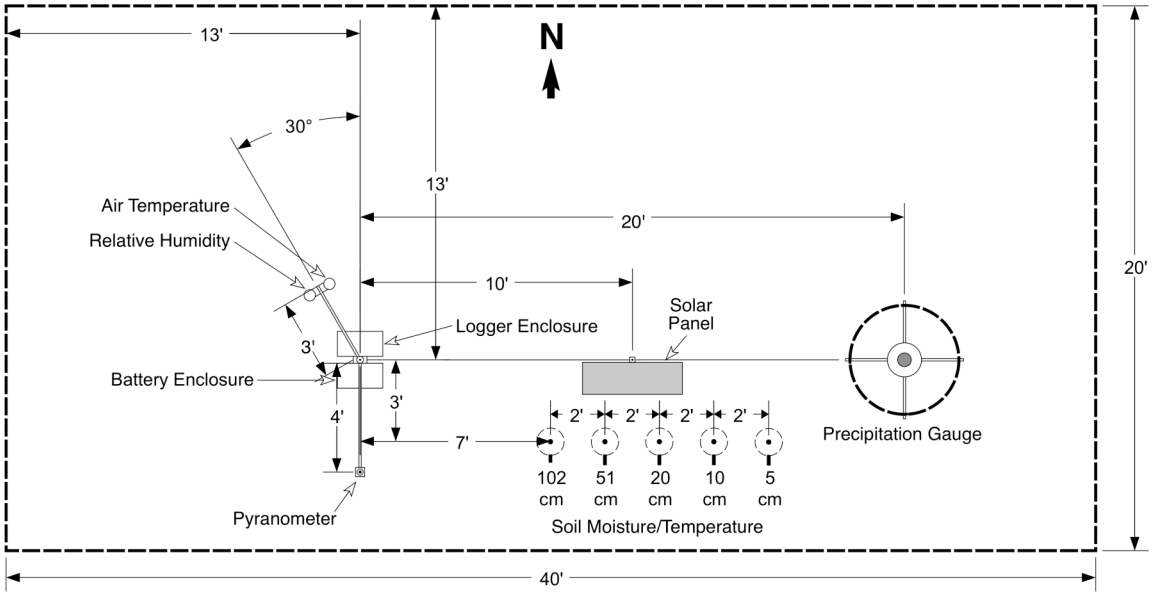


Figure 5. Plan view of a station plot that measures 20-by-40 feet and has a two-meter mast or tower.

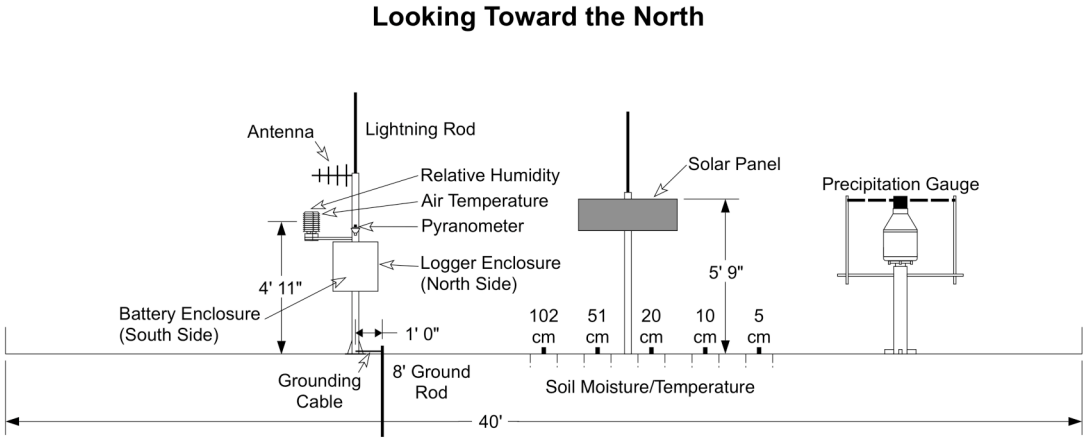


Figure 6. Profile view of a station plot that measures 20-by-40 feet and has a two-meter mast or tower.

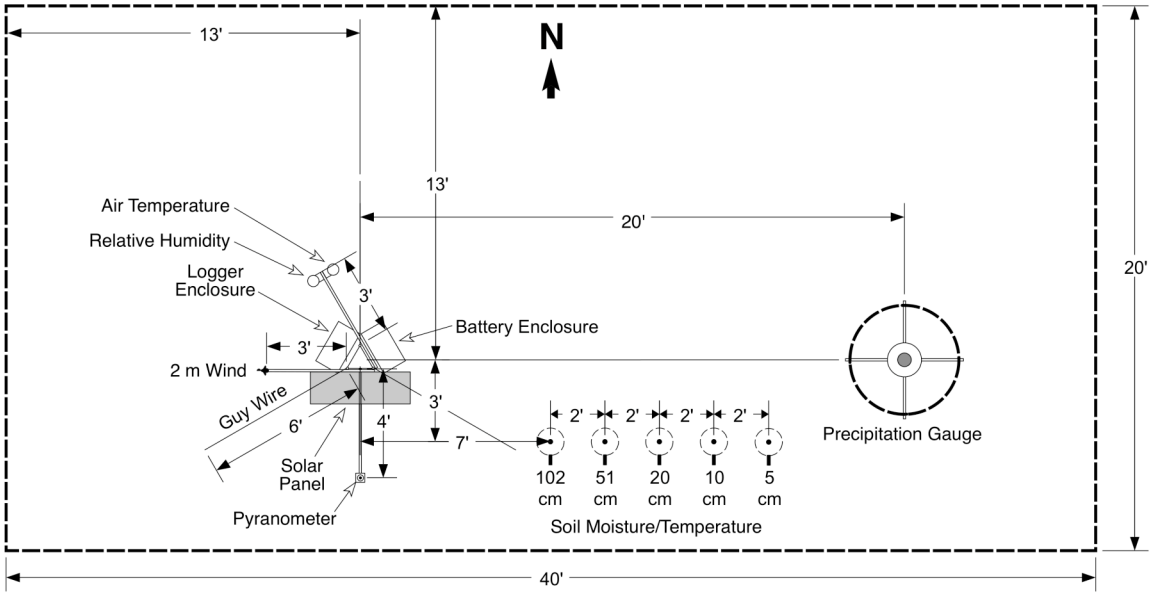


Figure 7. Plan view of a station plot that measures20-by-40-feet and has a single 7-foot tower section.

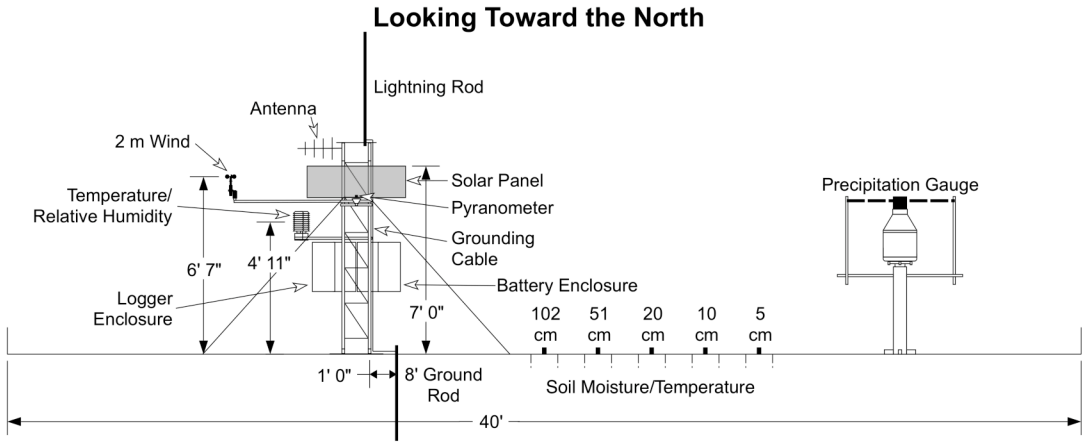


Figure 8. Profile view of a station plot that measures 20-by-40-feet and has a single 7-foot tower section.

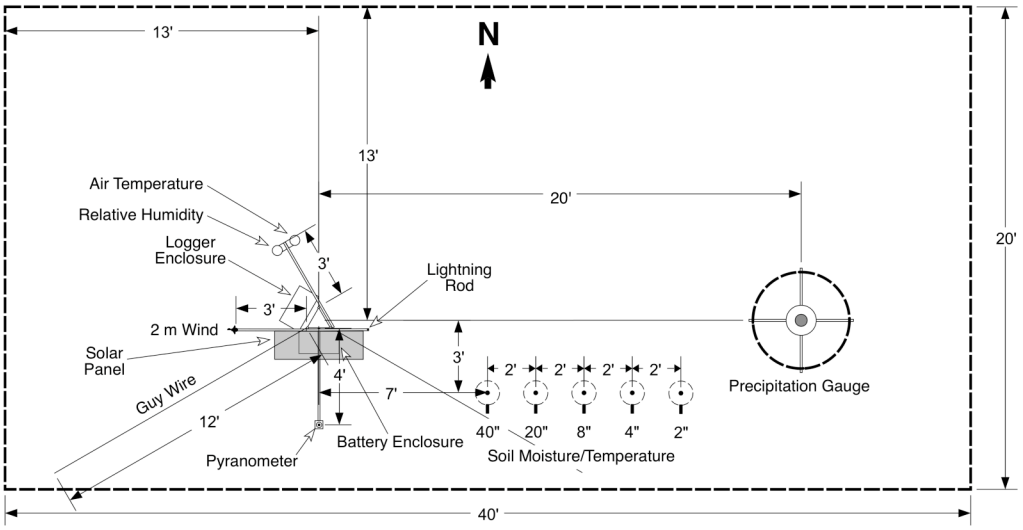


Figure 9. Plan view of a station plot that measures 20-by-40-feet and has a tall tower.

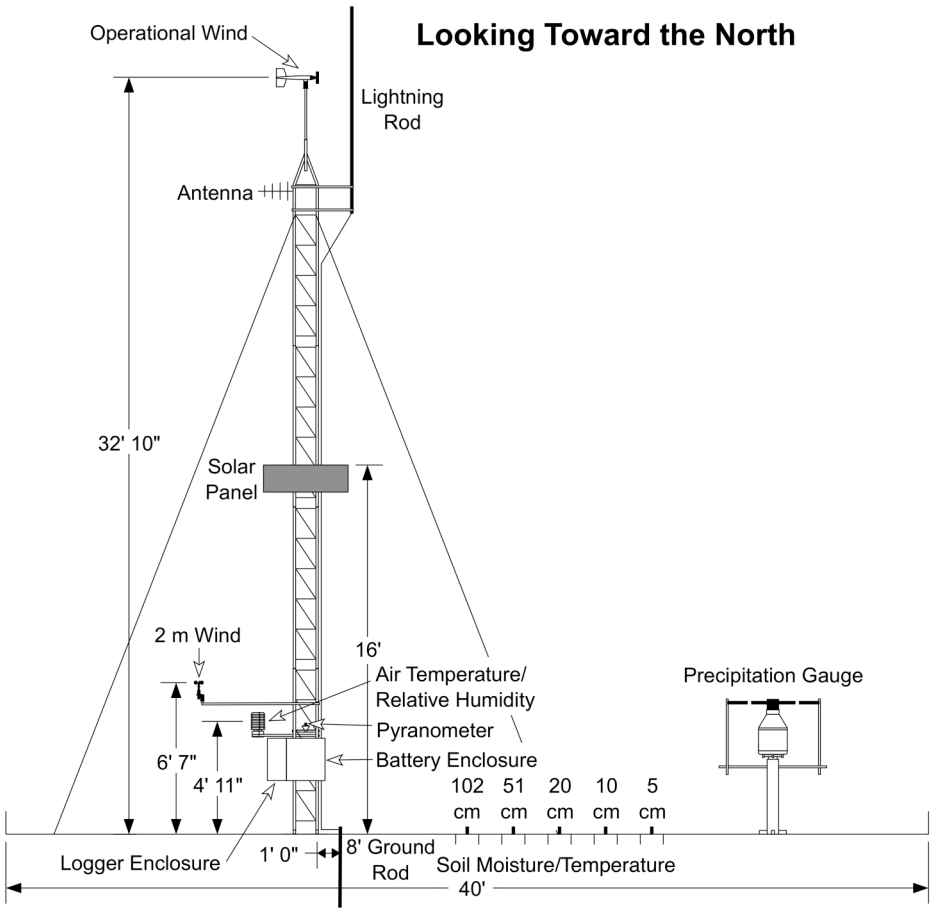


Figure 10. Profile view of a station plot that measures 20-by-40-feet and has a tall tower.

3 Routine Maintenance

3.1 Maintenance Performed by Technicians

The maintainers contracted to perform maintenance on NERON stations will make at least two visits to remote weather stations for routine maintenance per year: one in Spring and another in Fall. In addition, the maintainer will make one visit per year to each repeater and base station. The required tasks, which are explained in detail below, include documenting vegetation height and type on arrival and departure and any conditions that might affect sensor exposure or performance photographically, cutting the vegetation on the station plot, inspecting and cleaning sensors and equipment, emptying the weighing bucket precipitation gauge, adding oil and removing and adding antifreeze to the weighing bucket precipitation gauge, rotating sensors for calibration, performing a field intercomparison with reference sensors, and inspecting and adjusting guy wire hardware at tall tower sites.

3.1.1 Visit Schedule

3.1.1.1 Remote Weather Stations

Visits for routine maintenance will be required at the following times, driven by precipitation gauge and vegetation maintenance requirements (the Spring and Fall maintenance visits at remote stations and the yearly maintenance visit to repeater and base stations will be referred to throughout this document as *scheduled* maintenance visits, whereas all other visits will be referred to as *unscheduled* visits):

- Spring (scheduled): remove antifreeze from the weighing bucket precipitation gauge. Spring maintenance is to be completed no later than two months following the "Remove Mixture Date" given in Table 11 on Page 74 for each climate division.
- Fall (scheduled): add antifreeze to the weighing bucket precipitation gauge. Fall maintenance is to be completed no later than the "Add Mixture Date" given in Table 11 on Page 74 for each climate division.
- Whenever the weighing bucket precipitation gauge's bucket is 75% full or more, to empty the bucket (unscheduled),
- Whenever the vegetation on the site plot reaches a height of 4 feet or higher or anomalies are detected in sensor readings likely to be caused by excessively high vegetation (unscheduled).

Every routine maintenance task should be performed at the spring and fall visits. The following tasks should be performed at every visit:

- Take photos every time the vegetation is cut.
- Visually inspect the mast or tower, enclosures, radiation shields, sensors, precipitation gauge, cables, terrain, and vegetation for abnormalities and obstructions, documenting abnormalities photographically.
- Cut the vegetation if it is taller than 12 inches.
- Inspect and, if necessary, clean the radiation shields, solar panel, pyranometer, and skin temperature sensor, except that the solar panel need not be cleaned at a tall tower site unless

it is dirty enough that the solar cells are not visible beneath the clear surface over a portion of the panel.
- If out of level, level the pyranometer and the skin temperature sensor.
- Replace desiccant, if required for the enclosure installed at the site, and if the current desiccant will be older than 6 months before the next visit.
- If more than 0.5 inches of rain have fallen since the precipitation gauge bucket was last emptied and climatology or forecasts suggest that it will need to be emptied again before the next scheduled maintenance visit, empty the precipitation gauge bucket, add oil, and, if the visit is during the winter season, add antifreeze.

3.1.1.2 Repeater and Base Stations

Visits for routine maintenance at each repeater and base station will be required once per year, scheduled at the discretion of the maintainer, with the restriction that the time between visits at any one station does not exceed 14 months.

3.1.2 Documentation

3.1.2.1 Remote Weather Stations

All scheduled maintenance visits should be documented by completing the NERON Remote Station Maintenance Form for Technicians, found in the forms section of this document. If a printed paper version of the form is used by the technician in the field, the information entered by the technician must be transcribed to the electronic version and sent to the ISOS Office by FTP, as described in Section 7, Submission of Documentation, on Page 70, within 5 business days after completing the maintenance. The following paragraphs explain how the maintenance form should be completed, item-by-item.

"Station ID" is the 3- or 5-character station identifier. Note the date and time of arrival and departure in UTC, as indicated by the station's data logger.

NOTE: The logger enclosure should be opened and kept open throughout each maintenance visit to ensure that the technician visit flag is set to properly flag the data. The first step upon arriving at a site should be to open the enclosure, and the last step upon departing should be to close the enclosure.

Enter the name of the maintenance contractor and the name of the technician performing the maintenance in the indicated boxes. Place "X's" in the check boxes next to each task completed.

1. Arrival Photos. Before performing any maintenance, take arrival photos, as explained in the photographic documentation section below. The codes indicate the photo naming convention to use for each photo, and the blank spaces to their right can be used to record the ID number assigned to each photo by the digital camera to avoid confusion when renaming the photos later.
2. Visual Inspection. The results of the visual inspection should be indicated with a "Y" for "yes" and an "O" for "no" in each box in the visual inspection section. All abnormalities and obstructions removed should be explained in the notes section on the back of the form.

3. Vegetation Maintenance. Mark the check box to indicate that the vegetation has been cut as specified in the vegetation maintenance section below.
4. Tall Tower Maintenance. Mark all check boxes to indicate that all required tall tower maintenance has been completed at tall tower sites, as specified in the Tall Tower Maintenance section below.
5. General Maintenance. Indicate the completion of cleaning, leveling, and wind sensor maintenance, using a "Y" for "yes," an "O" for "no," or a "—" for not applicable in each box in the tables. In addition, enter an "NC" in the "DIRTY BEARINGS" box for the operational wind sensor (WSPD) if the tower was not lowered and the sensor was not checked. Mark the additional check boxes to indicate that all additional general maintenance has been completed.
6. Precipitation Gauge Maintenance. Mark all of the applicable check boxes to indicate that all maintenance appropriate to the season has been completed. In addition, enter the results of the calibration verification, if performed, and include the serial numbers of the precipitation gauge base and each vibrating wire sensor. If adding antifreeze to the bucket, indicate the amount in liters.
7. Sensor Rotation. If rotating any sensors, for either scheduled rotation or a problem, check the boxes of each sensor rotated. Fill out an individual trouble ticket form for a single sensor, or a mass install trouble ticket form for multiple sensors, or if replacing additional equipment.
8. Communication System Maintenance. Mark all check boxes to indicate that all required inspections have been completed. At sites without cellular modems, measure the forward and reflected RF power while transmitting, and indicate the values in watts in the "Arrival" row of the table. If the radio, antenna cable, or antenna are replaced, repaired, or adjusted, perform another test afterward and enter the values in the "Departure" row. Due to the infrequency of GOES transmissions, a second RF test may not be possible but should be performed if reasonably possible.
9. Departure Photos. After all maintenance is complete, but before securing the logger enclosure, take the departure photos, as explained in the photographic documentation section below. Identify and explain any notable findings photos that were taken in the notes section on the back of the maintenance form.
10. Mark each check box to indicate that each final step was completed.
11. Documentation Submitted to ISOS Office. Mark each check box to indicate that all required documentation has been submitted to the ISOS Office.

Finally, the maintenance contractor's representative to the NWS should enter her/his name and enter the date of submission.

3.1.2.2 Repeater and Base Stations

All scheduled maintenance visits should be documented by completing the NERON Repeater and Base Station Maintenance Form for Technicians, found in the forms section of this document. If a printed paper version of the form is used by the technician in the field, the information entered by the technician must be transcribed to the electronic version and sent to

the ISOS Office by FTP, as described in Section 7, Submission of Documentation, on Page 70, within 5 business days after completing the maintenance. The following paragraphs explain how the maintenance form should be completed, item-by-item.

"Station ID" is the 3- or 5-character station identifier. Note the date and time of arrival and departure in UTC. Enter the name of the maintenance contractor and the name of the technician performing the maintenance in the indicated boxes. Place "X's" in the check boxes next to each task completed.

1. Visual Inspection. The results of the visual inspection should be indicated with a "Y" for "yes" and an "O" for "no" in each box in the visual inspection section. All abnormalities and obstructions removed should be explained in the notes section at the bottom of the form.
2. Tower Maintenance. Mark the check boxes to indicate that all required tower maintenance has been completed at repeater stations with towers owned by NWS specifically for NERON, as specified in the Tall Tower Maintenance section below.
3. General Maintenance. Indicate the completion of cleaning, leveling, and wind sensor maintenance, using a "Y" for "yes," an "O" for "no," or a "—" for not applicable in each box in the tables. Mark the additional check boxes to indicate that all additional general maintenance has been completed.
4. Communication System Maintenance. Mark all check boxes to indicate that all required inspections have been completed. At sites without cellular modems, measure the forward and reflected RF power while transmitting, and indicate the values in watts in the "Arrival" row of the table. If the radio, antenna cable, or antenna are replaced, repaired, or adjusted, perform another test afterward and enter the values in the "Departure" row. Due to the infrequency of GOES transmissions, a second RF test may not be possible but should be performed if reasonably possible.
5. Mark each check box to indicate that each final step was completed.
6. Documentation Submitted to ISOS Office. Mark each check box to indicate that all required documentation has been submitted to the ISOS Office.

Finally, the maintenance contractor's representative to the NWS should enter her/his name and enter the date of submission.

3.1.3 Photographic Documentation

Photos should be taken with a digital camera set at its highest picture quality setting. The submitted photos should be JPEG format and 640 x 480 pixels in size. Except for notable findings photos, all photos should be taken in landscape, rather than portrait, orientation. If possible, set the camera to stamp the current date in the bottom corner of each photo. The photos should be taken with enough ambient light to clearly see the subjects of interest; photos after sunset, before sunrise and at night should be avoided, if possible. The photos should be named according to the following convention:

STIDYYYYMMDDX#.jpg

where

STID = the 3- or 5-character station ID
YYYY = year
MM = month
DD = day of the month
X = the code given in bold type for each photo in the list below
# = number the photos if multiple views are photographed for a single item.

NOTE: All compass directions referred to are referenced to true north.

<u>On Arrival</u>

1. East Soil Moisture Plots. From a position 2 feet north of the 4-inch soil moisture marker, showing the markers and the 2-foot-by-2-foot plots centered over the 2-inch, 4-inch, and 8-inch sensors: **SMEA**
2. West Soil Moisture Plots. From a position 2 feet north of the midpoint between the markers for the 20-inch and 40-inch soil moisture markers, showing the markers and the 2-foot-by-2-foot plots centered over the 20-inch and 40-inch sensors: **SMWA**
3. Skin Temperature Footprint. If a skin temperature sensor is installed, place the camera next to the sensor aimed directly downward: **FPA**
4. Inside Vegetation Height. Place the vegetation height gauge 4 feet east of the mast or tower. From a position 5 feet north and 3 feet west of the mast or tower, place the camera at the height of the tops of the vegetation and point the camera so that both the mast/tower and height gauge are in the frame: **IHA**
5. Outside Vegetation Height. Place the vegetation height gauge 10 feet south of the midpoint of the south edge of the station plot. From a position 10 feet south of the vegetation height gauge, place the camera at the height of the tops of the vegetation and point the camera so that the height gauge is in the center of the frame: **OH**

<u>Notable Findings</u>

Document notable findings that could affect sensor readings, equipment performance, safety, or that document theft or vandalism, such as wasp nests built on temperature or relative humidity

sensors, visible lightning damage, guy wire damage, etc., using the parameter ID as shown on a trouble ticket form for sensors or a logical string of no more than 5 characters for other photos. Give each photo string and an explanation in the notes section of the maintenance or trouble ticket form.

On Departure

1. East Soil Moisture Plots. Same positions as described above: **SMED**
2. West Soil Moisture Plots. Same positions as described above: **SMWD**
3. Skin Temperature Footprint. Same position as described above: **FPD**
4. Inside Vegetation Height. Same position as described above: **IHD**

Other

- Photo of GPS display, showing the reading taken at the center of the site plot, to accompany an installation, move, or update metadata form: **GPS**

Example:

The following example indicates the proper naming of photos for a fictitious maintenance visit on June 6, 2005, to North Foster, RI (FTFR1), as if it had all extended sensors installed:

FTFR120050606SMEA.jpg – arrival photo of east soil moisture plots
FTFR120050606SMWA.jpg – arrival photo of west soil moisture plots
FTFR120050606FPA.jpg – arrival photo of skin temperature sensor footprint
FTFR120050606IHA.jpg – arrival photo of inside vegetation height
FTFR120050606OH.jpg – photo showing outside vegetation height

FTFR120050606TAIR.jpg – notable finding photo showing a wasp nest built on the air temperature sensor
FTFR120050606GUYD.jpg – notable finding photo showing damage to a guy wire

FTFR120050606SMED.jpg – departure photo of east soil moisture plots
FTFR120050606SMWD.jpg – departure photo of west soil moisture plots
FTFR120050606FPD.jpg – departure photo of skin temperature footprint
FTFR120050606IHD.jpg – departure photo of inside vegetation height

3.1.4 Visual Inspection

Inspect the equipment listed below for any abnormalities, or obstructions, noting any findings or actions taken to fix any problems on the site maintenance or site visit form:

- Mast or tower
- Logger and battery enclosures
- Sensor radiation shields
- All sensors, including sub-surface sensor plots
- Precipitation gauge
- All sensor and electrical cables
- Terrain in and surrounding the site plot
- Vegetation in and surrounding the site plot

3.1.5 Vegetation Maintenance

Cut vegetation to a height between 1 and 3 inches over the entire plot to provide a firebreak around the station equipment and to prevent the vegetation from growing high enough to impede wind flow to the above-ground sensors. Use either a string trimmer or a hand-pushed lawn mower.

Rake the grass and dispose of it as allowed by the site host. If the host does not object to leaving the grass on the ground outside the station plot, deposit it so that it is downwind of the station relative to the prevailing wind directions, if possible, to avoid affecting sensor readings.

3.1.6 Tall Tower Maintenance

Use a level held against the tower to check tower plumb, and adjust the guy wire turnbuckles to plumb the tower, if necessary. Take cross readings with the level to ensure plumb in both dimensions. It is easiest to use two magnetic levels, which can be stuck in place to the tower.

Adjust the guy wire tension to prevent the top of the tower from wobbling excessively. This could affect the wind and pyranometer readings and put excessive stress on the guy wires and anchors in high winds. Leave some slack in the warm months so that when the guy wires contract in the cold months, they won't pull the tower base into the ground.

Perform the following safety inspections once per year:

1. Inspect the guy wire anchors to verify that they aren't loose and haven't moved upward since being installed.
2. Inspect the guy wire hardware, tighten any loose hardware, and replace any rusted hardware.
3. Inspect the guy wires, making sure they aren't frayed or rusted.
4. Inspect the tower base to make sure that it is adequately anchored and hasn't moved since being installed.
5. Inspect the tower to verify that it isn't rusted or bent.
6. Inspect the tower hardware, tighten any loose hardware, and replace any rusted hardware.

3.1.7 Lowering and Raising a Tall Tower

At tall tower sites, the tower should be lowered to perform maintenance on the operational wind sensor, the communication antenna, and the solar panel. Note that this only needs to be done once per year. The procedures for lowering and raising the tower are listed below. A gin pole and a vehicle fitted with an electric winch are required. The gin pole provides mechanical advantage when the tower is near horizontal by elevating the erection cable.

Lowering

1. Position the vehicle on a bearing of 240° true from the tower with its winch oriented toward the tower.
2. Set up the gin pole and feed the winch cable attached to the tower through the gin pole's pulley.
3. Attach the tower's winch cable to the winch's cable and take up the slack with the winch.
4. Disconnect the southwest guy wire from its anchor by unscrewing its turnbuckle.
5. Place a support on a bearing of 60° true from the tower to hold the top of the tower a few feet above ground level when it is lowered.
6. Carefully lower the tower onto the support. Use the north and southeast guy wires to prevent the tower from swaying to either side as it is lowered.

Raising

1. Verify that the gin pole, winch cable, and vehicle are in position and secure.
2. Carefully raise the tower to its vertical position. Use the north and southeast guy wires to prevent it from swaying to either side.
3. Reconnect the southwest guy wire to its anchor by screwing the turnbuckle eye attached to the guy wire into the turnbuckle until there is not slack in the guy wire.
4. Disconnect the winch cable from the winch, and take the gin pole down.
5. Secure the tower's winch cable to the bottom of the tower.
6. Adjust the guy wires to plumb the tower and set the guy wire tension. The tension should be left slightly loose during the warm season to prevent contraction in the winter from pulling the tower base into the ground.

3.1.8 General Maintenance

General maintenance includes cleaning and leveling sensors and equipment, checking wind sensors for noisy bearings, replacing desiccant in the logger enclosure, tightening wire terminals, verifying the operation of the door switch, and performing a load test on all batteries. At tall tower sites, it is only necessary to maintain the operational wind speed sensor, solar panel, and antenna, for which lowering the tower is necessary, once per year.

3.1.8.1 Cleaning

Check the radiation shields and solar panel for dirt or obstructions every visit, whether for maintenance or to fix a problem, and clean them if their surfaces are dirty or covered with snow. A radiation shield qualifies as dirty if there are any substances on it that are darker than its white surface, which could absorb solar radiation and heat the shield more than if clean, or if there are any objects that could obscure air flow over the sensor. A solar panel qualifies as dirty if there are any substances or obstructions visible that could reduce the amount of solar radiation reaching the solar cells. Clean the radiation shields and solar panel at least once per year, even if they appear to be clean.

Check the battery and voltage regulator terminals for corrosion at every scheduled maintenance visit (i.e., once in the spring and once in the fall) and clean them with a wire brush to remove any corrosion. At sites where this is a recurring problem, apply petroleum jelly to the terminals to seal out oxygen and prevent corrosion.

3.1.8.2 Cleaning/Leveling

Note that at a tall tower site, the leveling should only be done after the tower has been raised for the final time and after the guy wires have been adjusted to bring the tower into plumb.

The pyranometer and skin temperature sensor lenses should be checked for dirt and cleaned if dirty at every site visit. They qualify as dirty if there are any foreign substances or objects visible on the lenses or that obstruct the lenses' views of the sky or ground, as applicable. They should both be cleaned at every scheduled maintenance visit, even if they appear clean. The pyranometer can be cleaned with water and a soft paper towel. The skin temperature sensor should be cleaned only with a cotton swab dipped in methanol. Do not double-dip the cotton swab, to avoid contaminating the methanol supply.

The precipitation gauge level should be checked at every visit during which the precipitation gauge top is removed. Remove the bucket and check the level of the base by placing a level on the top of the gauge flange from which the vibrating wire sensors hang. Take cross readings to ensure level in both dimensions. Adjust the level of the base by adjusting the three bolts and leveling nuts at the bottom of the gauge. Replace the bucket and level it by adjusting the nuts that secure the vibrating wire sensors. Leveling the bucket is critical, since it ensures that each vibrating wire shares the weight of the bucket equally.

3.1.8.3 Wind Sensor Maintenance

During the spring and fall scheduled maintenance visits, check both the 2-meter anemometer and the operational wind sensor for bearing noise that indicates the presence of dirt, which

introduces excessive friction. Listen for a grinding or rattling sound. A clean hissing sound after a sensor has been deployed for a number of months is normal and does not qualify as "noisy."

The 2-meter anemometer cups and the operational wind sensor propeller should be cleaned if fouled with spider webbing or excessively dirty, since those conditions could alter the wind flow around the cups or propeller.

3.1.8.4 Other General Maintenance

If the logger enclosure is not fitted with a one-way vent that allows air to escape but not to enter or is not fitted with cable glands but simply has openings for cables to enter the box that must be sealed with duct seal, then replace 16 units (16 oz.) of desiccant every 6 months, or at least during the spring and summer scheduled maintenance visits.

During the scheduled maintenance visit in the spring, tighten all wire terminal connections in the logger enclosure, battery enclosure, and in the precipitation gauge.

Verify that the door switch is operating correctly by verifying that the door open indication in the logger is active with the switch in the door open position, that the door closed indication becomes active with the switch in the door closed position, and that the indication returns to the door open indication when the switch is returned to the door open position.

Perform a load test on each battery with a 12-volt battery load tester that can be set at a range of amp ratings. The batteries must be fully charged to test them, so if there was little direct sunshine on the previous day and little during the current day, then the batteries cannot be tested. Choose the amp setting appropriate for the battery to be tested, which is determined by the current capacity of the battery. If the battery has a cold cranking amp rating, set the tester for half of that value. Load the battery for the time period specified in the tester instructions and read the voltage. Replace any batteries that fail the test.

3.1.9 Precipitation Gauge Maintenance

Precipitation gauge maintenance includes emptying the gauge bucket (and refilling it with antifreeze if during the winter season), verifying the operation of the rim heater, and recalibrating the three vibrating wire sensors or performing a calibration check.

The bucket must be emptied at each scheduled maintenance visit, and it must be emptied at an unscheduled visit if more than 0.5 inches of rain have fallen since the precipitation gauge bucket was last emptied and climatology or forecasts suggest that it will need to be emptied again before the next scheduled maintenance visit.

The gauge must be fully recalibrated when any of the following occurs:

- One of the sensors is replaced,
- The gauge mount is changed in some way (including releveling),
- The calibration verification indicates that the average of the frequencies reported by the three sensors is off by more than 2% from the previous calibration, or
- Any one sensor's frequency is off by more than 3% from the previous calibration during the verification.

A calibration verification is required once per year, except in years when the gauge has already been fully calibrated.

3.1.9.1 Emptying the Precipitation Gauge Bucket

(Adapted from NOAA ATDD "Precipitation Gauge Maintenance Guide")

1. Refer to the maps in Appendix A to determine the station's climate division. Find the climate division's entry in Table 11 beginning on Page 72 and read straight across to determine the add mixture date and the amount to add. Remove the mixture at the remove mixture date. If the current date is later than the remove mixture date and earlier than the add mixture date (warm months), then skip to step 3.

   NOTE: The antifreeze to be used is propylene glycol.

2. Refer to the Material Safety Data Sheets for proper handling procedures. Pre-measure the required amount of anti-freeze mixture for the precipitation gauge, using a 2-liter measuring beaker. An additional bucket will be required if more than 2 liters of antifreeze must be added.

3. Pump the liquid from the gauge into a bucket that can hold at least 3.5 gallons, as shown, using the gauge siphon.



4. Dispose of the liquid. If the liquid is water only, then pour into a storm drain or spread on the ground. If the liquid contains anti-freeze, then pour it into a carboy for proper disposal.

5. Slowly pour the new anti-freeze mixture into the top of the gauge, if the current date is later than the add mixture date and earlier than the remove mixture date (cold months).


6. Slowly add 0.5 quart of light-weight mineral oil, if the current date is later than the remove mixture date and earlier than the add mixture date (warm months).

7. As soon as possible after completing Step 6 (preferably within 5 minutes), use a PDA with a connection to the station data logger to set the “Emptied Bucket” remark by checking the “Emptied Bucket” box in the remarks section for Campbell stations and by entering “256” in the Note field of the manual entry page for Vaisala stations.

3.1.9.2 Rim Heater Check

3.1.9.2.1 Campbell Scientific Data Logger-Based Stations

(TO BE INSERTED)

3.1.9.2.2 Vaisala Data Logger-Based Stations

(TO BE INSERTED)

3.1.9.3 Calibration

(From NOAA/ATDD & NCDC Climate Reference Network Documentation Manual)

Equipment

- 11 Troemer-certified machined brass 1000g calibration weights with an aluminum base/centering weight
- Computer w/MS Excel and CRN GEONOR Rain Gauge Calibration Program

Test Method

The GEONOR Rain Gauge has a fill capacity of 12 liters. At 4°C, one liter of water weighs 1000g. The machined weights weigh 1000.0g ±0.1g and represent one liter of water. The known weights are added to the gauge and the output is recorded. From these values, calibration curves are developed using Excel's linear regression feature.

Test Procedure

1. Empty the gauge bucket and clean it to remove all foreign matter and liquids and dry it, disposing of antifreeze as specified in section 3.1.9.1 on Page 17, Emptying the Precipitation Gauge Bucket.
2. Record all precipitation gauge serial numbers on the GEONOR precipitation gauge calibration sheet.
3. After the rain gauge has been properly installed and leveled at the test site, record the initial output. Add the aluminum base/centering weight to the bucket, wait two minutes, and record the frequencies of the individual sensors. Add the first brass weight, wait two minutes and record the frequency. Repeat ten more times to reach the maximum gauge capacity.
4. Enter the values into the special "GEONOR Rain Gauge Calibration Program," shown in Figure 1, to perform a second-order linear regression analysis to determine the equation to relate frequency to rainfall depth (Depth (mm) vs. F-Fo).
5. Enter the coefficients into the site-specific data logger program.

GEONOR CALIBRATION PROGRAM

SERIAL NUMBER= 12800 DATE = 10/17/2001

STATION: ID - LOCATION = NC-ARBORETUM

VOLUME (mL)		DEPTH (cm)		FREQ. (F) (Hz)		F - F0 (Hz)
0		0		1053.4	(= F0)	0
1000		5		1310.9		257.5
2000		10		1523		469.6
3000		15		1705.4		652
4000		20		1868.9		815.5
5000		25		2017.9		964.5
6000		30		2155.5		1102.1
7000		35		2284.1		1230.7
8000		40		2405.3		1351.9
9000		45		2520.9		1467.5
10000		50		2629.5		1576.1
11000		55		2734.5		1681.1
12000		60		2833.8		1780.4

EQUATION : $DEPTH = A(F - F0) + B(F - F0)^2$

A = x coef., B = x^2 coef. and (F - F0) = x

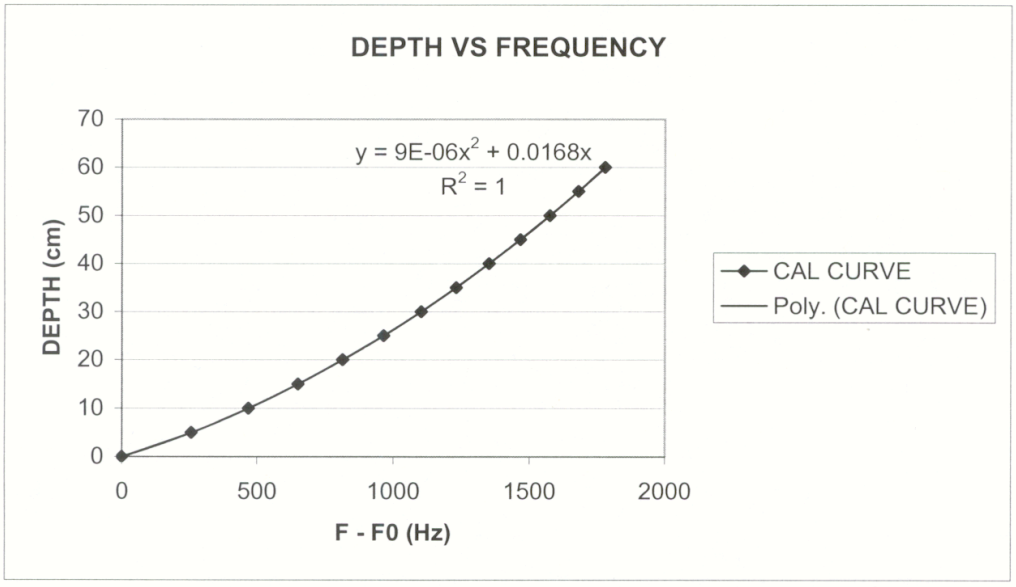


Figure 11. Sample GEONOR precipitation gauge calibration program input and resulting calibration curve.

3.1.9.4 Calibration Verification

1. Empty the gauge bucket, clean it to remove all foreign matter and liquids, and dry it, disposing of antifreeze as specified in Section 3.1.9.1 on Page 17, Emptying the Precipitation Gauge Bucket.
2. Enter the serial numbers of the gauge base and each of the three vibrating wire sensors on the maintenance form. Obtain and enter the 1000 g precipitation values reported by the three vibrating wire sensors and their averages from the previous calibration on the maintenance form.
3. Place either the aluminum base/centering calibration weight or 1000 mL of water, measured with a volumetric flask, in the bucket, wait two minutes, and record the precipitation values reported by the individual sensors, their average, and the percentage differences from the previous calibration on the maintenance form.
4. If the precipitation value reported by any individual sensor differs from that in the previous calibration by more than 3%, or if the average of the precipitation values reported by all three sensors differs from the average of the precipitation values reported by all three sensors in the previous calibration by more than 2%, then perform a calibration, as described in Section 3.1.9.3 on Page 21, Calibration.

3.1.10 Field Intercomparison of Sensors

(TO BE INSERTED)

3.1.11 Sensor Rotation Intervals

Replace sensors and return the removed sensors for recalibration, following the schedule in Table 1 below for specific sensor brands and models. These intervals reflect times after which sensor calibration drift can become excessive, based on practical experience.

Table 1. Rotation intervals for specific sensor brands and models.

Sensor	Rotation Interval (months)
Thermometrics PRTD air temperature sensor	__
RM Young Wind Monitor direction indicator	48
RM Young Wind Monitor nose cone	36
RM Young Wind Sentry	18–24

NOTE: A range of rotation intervals means that rotation should occur at the smaller interval, if possible, but can wait until the longer interval has passed if inventory is not available.

3.1.12 Communication System Maintenance

Use an RF power meter placed between the transmitter and the antenna cable at sites with GOES or LETS radios. Verify that the meter is rated or set for the frequency range of the transmitter. Measure and record the forward and reflected power in the "Arrival" row of the RF power table on the maintenance or site visit form. If any changes are made to the communication system during the visit, then perform and record the results of the final RF power test in the "Departure" row.

Table 2 below lists forward power (W_f) values and the corresponding reflected power (W_r) values for standing wave ratios (SWR) of 1.5:1, 2:1, and 3:1. For optimum communication quality, the SWR should be less than 1.5:1, though a value less than 2:1 is acceptable. If the SWR is 2:1 or greater but less than 3:1, then there is a problem that should be fixed soon, though the radio can continue to operate normally. If the SWR is 3:1 or greater, then the radio can be damaged and should be turned off immediately until the problem is fixed.

Table 2. Forward power (W_f) and corresponding reflected power (W_r) values for standing wave ratios of 1.5:1, 2:1, and 3:1 for radio-antenna systems.

W_f (W)	W_r 1.5:1 SWR (W)	W_r 2:1 SWR (W)	W_r 3:1 SWR (W)
10.0	0.40	1.11	2.50
9.0	0.36	1.00	2.25
8.0	0.32	0.89	2.00
7.0	0.28	0.78	1.75
6.0	0.24	0.67	1.50
5.0	0.20	0.56	1.25
4.0	0.16	0.44	1.00
3.0	0.12	0.33	0.75
2.0	0.08	0.22	0.50
1.5	0.06	0.17	0.38
1.0	0.04	0.11	0.25
0.8	0.03	0.09	0.20
0.6	0.02	0.07	0.15
0.4	0.02	0.04	0.10
0.2	0.01	0.02	0.05

Check all of the coaxial cable connectors for security, damage, corrosion, or bent center pins; check the antenna for damage; and check the entire length of coaxial cable for wear, damage, or cuts. Any of these conditions could attenuate RF signal power at the antenna and/or reflect power toward the transmitter, increasing the standing wave ratio and reducing transmission power further. Replace or repair damaged components and replace or clean corroded parts. In addition, if the SWR is too high, check that there are no nearby metal objects above, below, or to either side of the antenna.

3.1.13 Final Tasks

Before leaving a site for any kind of visit, complete the following:

1. Check all datalogger input locations for normal readings to ensure that all sensors are wired properly and are operating.
2. Verify that the station is communicating with the data monitoring and collection facility. If a GOES site, the next transmission window is more than a few minutes in the future, and changes have been made to the communication system since its last transmission, try at least to stay near enough to the station to come back if there is a problem with the next transmission.
3. Verify that all openings in the logger enclosure, if it is not outfitted with cable glands, are sealed with duct seal. In addition, verify that all conduit openings are sealed with duct seal to keep moisture out as much as possible.
4. Keep the logger enclosure door open until just before leaving the site. Upon leaving, record the departure time on the maintenance form and/or trouble ticket form(s), as indicated by the logger's clock. This will allow QA personnel to confirm that the station sensor data has been flagged appropriately during the maintenance visit time.
5. Finally, lock the logger enclosure and all battery enclosures before departing.

3.2 Maintenance Performed by Site Hosts, Observers, or WFOs

Site hosts, observers, and WFO personnel are encouraged, but not required, to assist the maintenance contractors by performing preventive maintenance at sites.

3.2.1 Visit Schedule

Visits are suggested at the following times, driven by vegetation and precipitation gauge maintenance requirements. Note, however, that these visits must be coordinated with the maintenance contractor, so that the contractor can better schedule visits by its technicians.

- Whenever the vegetation on the site plot reaches a height of 12 inches or higher, to cut the vegetation
- Whenever the weighing bucket precipitation gauge's bucket is 75% full or more, to empty the bucket (WFO personnel only)

3.2.2 Documentation

All maintenance visits should be documented by completing and submitting the original NERON Site Maintenance Form for Hosts, Observers, and NWS WFOs, found in the forms section of this document to the ISOS Office, preferably within 5 business days of performing the maintenance. The originals, not copies, should be submitted, so that they can be scanned and added to the electronic COOP metadata database. The following paragraphs explain how the maintenance form should be completed, item by item.

"Station ID" is the 3- or 5-character station identifier. Note the date and time of arrival and departure, in local STANDARD time (add one hour to local time during daylight saving time). Enter the name of the person performing the maintenance and circle the type of maintainer in the indicated boxes. Place "X's" in the check boxes next to each task completed.

1. Visual Inspection. The results of the visual inspection should be indicated with a "Y" for "yes" and an "O" for "no" in each box in the visual inspection section. All abnormalities and obstructions removed should be explained in the notes section at the bottom of the form.
2. Vegetation Maintenance. Mark the check box to indicate that the vegetation has been cut as specified in the vegetation maintenance section below.
3. General Maintenance. Mark check box next to each item that needed to be cleaned.
4. Precipitation Gauge Maintenance. Mark all of the applicable check boxes to indicate that all maintenance appropriate to the season has been completed. If adding antifreeze to the bucket, indicate the amount in liters.
5. Mark each check box to indicate that each final step was completed.

Finally, the person performing the maintenance should sign the form and enter the date of submission.

3.2.3 Visual Inspection

Inspect the equipment listed below for any abnormalities, or obstructions, noting any findings or actions taken to fix any problems on the site maintenance form:

- Mast or tower
- Logger and battery enclosures
- Sensor radiation shields
- All sensors, including sub-surface sensor plots
- Precipitation gauge
- All sensor and electrical cables
- Terrain in and surrounding the site plot
- Vegetation in and surrounding the site plot

3.2.4 Vegetation Maintenance

Cut vegetation to a height between 1 and 3 inches over the entire plot to provide a firebreak around the station equipment and to prevent the vegetation from growing high enough to impede wind flow to the above-ground sensors. Use either a string trimmer or a hand-pushed lawn mower.

3.2.5 General Maintenance

General maintenance includes cleaning the sensor radiation shields, the solar panel, and the pyranometer. Inspect the solar panel, if not a tall tower site, and the radiation shields and clean them if their surfaces are dirty or covered with snow. A radiation shield qualifies as dirty if there are any substances on it that are darker than its white surface, which could absorb solar radiation and heat the shield more than if clean, or if there are any objects that could obscure air flow over the sensor. A solar panel qualifies as dirty if there are any substances or obstructions visible that could reduce the amount of solar radiation reaching the solar cells.

Check the pyranometer lens for dirt and clean it by spraying it with a small amount of water and wiping it clean with a soft paper towel. It qualifies as dirty if there are any foreign substances or objects visible on the lens.

3.2.6 Precipitation Gauge Maintenance (WFO Personnel Only)

(Adapted from NOAA ATDD "Precipitation Gauge Maintenance Guide")

1. Refer to the maps in Appendix A to determine the station's climate division. Find the climate division's entry in Table 11 beginning on Page 72 and read straight across to determine the add mixture date and the amount to add. Remove the mixture at the remove mixture date. If the current date is later than the remove mixture date and earlier than the add mixture date (warm months), then skip to step 3.

   NOTE: The antifreeze to be used is propylene glycol.

2. Refer to the Material Safety Data Sheets for proper handling procedures. Pre-measure the required amount of anti-freeze mixture for the precipitation gauge, using a 2-liter measuring beaker. An additional bucket will be required if more than 2 liters of antifreeze must be added.

3. Pump the liquid from the gauge into a bucket that can hold at least 3.5 gallons, as shown, using the gauge siphon.

4. Dispose of the liquid. If the liquid is water only, then pour into a storm drain or spread on the ground. If the liquid contains anti-freeze, then pour it into a carboy for proper disposal.

5. Slowly pour the new anti-freeze mixture into the top of the gauge, if the current date is later than the add mixture date and earlier than the remove mixture date (cold months).

6. Slowly add 0.5 quart of light-weight mineral oil, if the current date is later than the remove mixture date and earlier than the add mixture date (warm months).

7. As soon as possible after completing Step 6 (preferably within 5 minutes), use a PDA with a connection to the station datalogger to set the "Emptied Bucket" remark by checking the "Emptied Bucket" box in the remarks section for Campbell stations and by entering "256" in the Note field of the manual entry page for Vaisala stations.

3.2.7 Reporting Problems

Site hosts and observers should report any problems noticed at a site that could affect any sensor readings or the operation of the station by phone or email to the Data Acquisition Program Manager (DAPM) at the local National Weather Service forecast office. The DAPM should then relay any reports to Gavin Essenberg, the NERON Systems Integration Manager at 405-204-1274 or Gavin.Essenberg@noaa.gov. In the event that the local DAPM is unavailable or unable to relay problem reports, site hosts and observers should contact Gavin Essenberg directly.

Each report should include as much detail as possible about the problem, if known, including station ID, start date, end date, equipment and/or sensors affected, and a description of the problem.

4 Problem Fixes

4.1 Problem Reporting

Problem reporting between the ISOS Office and the maintenance contractor is two-way. The ISOS Office will report problems noticed by the data monitoring/QA facility and those reported by sites hosts, observers, and WFOs and their required fix dates to the maintenance contractor. The maintenance contractor will report any problems noticed that could affect any sensor readings or the operation of the station, even if already fixed, to the ISOS Office. Each report should include as much detail as possible about the problem, if known, including station ID, start date, end date, equipment and/or sensors affected, and a description of the problem.

4.2 Documentation

Problem reports in both directions will be made using an electronic version of the NERON Trouble Ticket form transmitted by email. The form must then be completed by the technician performing the fix. If a printed paper version of the form is used by the technician in the field, the information entered by the technician must be transcribed to the electronic version and sent to the ISOS Office by FTP. All forms and photos should be submitted to the ISOS Office, as described in Section 7, Submission of Documentation, on Page, 70 within 5 business days after completing the fix. The following paragraphs explain how the trouble ticket forms should be completed, item by item.

The NERON Station Trouble Ticket/Site Visit Form is used for reporting a single problem with a single site, reporting the fix of a single problem, and/or reporting routine maintenance performed at times other than the scheduled spring and fall maintenance visits. If reporting multiple problems at a single site, fill out one trouble ticket form per problem.

The NERON Trouble-Ticket Form for Mass Installs, Fixes, or Moves is used to save paper and time when installing, fixing, or removing multiple pieces of equipment at once at a single site. When moving a site to a new location nearby the old location, use this form to document the serial numbers of all equipment removed. Use the NERON Metadata Form to document all equipment installed at the new location. This form should not be used for reporting a problem, unless it is also fixed at the same time that it is reported.

Trouble Ticket/Site Visit Form

1. Check the “Site Visit Only” check box if the form applies only to maintenance at a time other than the scheduled spring and fall maintenance visits, and no problems were fixed. If used for a problem fix during a scheduled maintenance visit, report the maintenance tasks completed on the NERON Site Maintenance Form for Technicians, rather than on this form.
2. Enter the 3- or 5-character station ID and circle “REMO” if a remote (weather) station, “RPTR” if a radio repeater site only, and “BASE” if a radio base station (LETS network access point). If the date on which the problem began is known, enter it in the “DATE TRACED TO” box. If reporting a problem that has not yet been reported, enter the name of the person reporting the problem and the name of the organization with which the reporter is affiliated, if applicable; otherwise, enter “N/A”. Enter the date the problem was noticed in the “DATE PROB NOTICED” box.

3. Circle or select (if filling out electronically) the equipment or sensor affected by the problem being reported. If the problem could be located in more than one item, and the specific item needing to be fixed is unknown, circle or select each item where the problem could be located. See Table 3 on Page 34 for an explanation of all of the equipment and sensor IDs.
4. Describe the problem as specifically and concisely as possible in the problem description area.
5. The box just above the heavy dotted line is reserved for use by the ISOS Office.
6. If fixing a problem, enter the arrival and departure dates and times in UTC, as indicated by the data logger, the name of the maintenance contractor, and the name(s) of the technician(s) performing the fix.
7. If more than one sensor or unit of equipment is circled or selected in the problem report area, place an X over the single sensor or unit fixed. If multiple sensors or units were fixed to address this problem, use the form for mass installs, fixes, or moves.
8. Circle the appropriate type of fix: on-site repair (OSR), replacement (RPL), initial install (INI), removal (RMV), or no action taken (NAT). NAT should be used in situations where either the problem seemed to be with the sensor or unit of equipment marked on the trouble ticket form, but was actually with another sensor or unit of equipment, the problem resolved itself by the time the technician arrived, or, for some other reason, no action was taken on that particular sensor/equipment.
9. Enter the old and new sensor/equipment serial numbers, as applicable; the old serial number must be entered for OSR, RPL, RMV, and NAT, and the new serial number must be entered for RPL and INI. Do not leave any serial number information blank when it is expected.

   If an already installed sensor or unit of equipment does not have a serial number attached, use the following convention established for applying one on the trouble ticket and sensor tag:

   Do not install a new sensor or unit of equipment that hasn't had a serial number assigned and marked.

   If an old sensor or unit of equipment, which should be installed, is missing (i.e., due to theft), then circle RPL and enter "NONE" for the old serial number.

   Enter all leading zeros in serial numbers (e.g., the database *does* distinguish between 7 and 0007).
10. Describe the fix and any findings about the cause(s) of the problem in the fix description area.
11. If replacing or installing a new pyranometer or soil moisture sensor, contact an operator at the data collection facility to have the new serial number and calibration coefficients entered to maintain accurate real-time data. Note the name of the operator and the time called.
12. The box just above the heavy dotted line is reserved for use by the ISOS Office.
13. If this is not a scheduled spring or fall maintenance visit, then fill out the bottom site visit portion of the trouble ticket.
14. Circle the purpose of the visit.

15. Indicate the results of the visual inspection with a "Y" for "yes" and an "O" for "no" in each box in the visual inspection section. All abnormalities and obstructions removed should be explained in the notes section at the bottom of the form.
16. Indicate the completion of cleaning and leveling, using a "Y" for "yes" and an "O" for "no" in each box in the tables.
17. When fixing a radio, antenna cable, or antenna problem at a site without a cellular modem, measure the forward and reflected RF power while transmitting before fixing the problem, if possible, and indicate the values in watts in the "Arrival" row of the table. Perform another test after the fix and enter the values in the "Departure" row. Due to the infrequency of GOES transmissions, a second RF test may not be possible but should be performed if reasonably possible.
18. If cutting the vegetation or replacing the desiccant, mark the appropriate check boxes.
19. If emptying the precipitation gauge bucket, adding antifreeze, and/or adding oil, mark the applicable check boxes. If adding antifreeze to the bucket, indicate the amount in liters. If a precipitation gauge calibration is performed as part of a problem fix or diagnostic procedure, enter the results of the calibration and include the serial numbers of the precipitation gauge base and bucket.

Table 3. Equipment and parameter IDs used in the instrument database and on trouble ticket and metadata forms.

Parameter ID	Explanation
LOGG	Data logger
WIRPAN	Data logger wiring panel (Used only for Campbell CR10X)
PRTMOD	Module add-on to expand data logger ports
MUX	Multiplexer
RADIO	Primary data communication radio (LETS, CELL, or GOES)
RFMODM	RF modem, if a separate unit from the radio
RS232IF	RS-232 interface (required to interface RS-232 devices with Campbell CS I/O port)
SERSRV	Serial server (base station equipment)
ETHHUB	Ethernet hub or switch (base station equipment)
ROUTER	Ethernet router (base station equipment)
SERADS	Wireless serial radio installed at the station for communication with the site host's PDA
SERADH	Wireless serial radio installed at the location of the site host's PDA
PDA	PDA used by the site host to communicate with the station
SOLRP	Primary solar panel; connected to the battery(ies) that are connected directly to the data logger and are isolated from the precipitation gauge heater
SOLRPS	Secondary solar panel; connected to the battery(ies) that are connected directly to the precipitation gauge heater and are isolated from the data logger
ACTRAN	AC 120V to DC ~15V transformer installed at AC-powered sites
SRGSUP	Surge suppressor installed on the AC line at AC-powered sites

Parameter ID	Explanation
UPS	Uninterruptible power supply. Used at base stations where there is not access to a LETS agency-owned UPS.
TPS	Telnet or internet power switch (base station equipment)
VREG	Primary voltage regulator; connected to the battery(ies) that are connected directly to the data logger and are isolated from the precipitation gauge heater
VREGS	Secondary voltage regulator; connected to the battery(ies) that are connected directly to the precipitation gauge heater and are isolated from the data logger
BATCHG	AC-powered battery charger
BATV	Primary battery(ies); connected directly to the data logger and isolated from the precipitation gauge heater
BATVS	Secondary battery(ies); connected directly to the precipitation gauge heater and isolated from the data logger
TAIR	1.5 meter air temperature sensor
PRECIP	Refers specifically to the precipitation gauge base, which holds the vibrating wire sensors and the bucket; does not include the gauge top. Parameter ID refers to accumulation data integrated from all three vibrating wire sensors by the logger's internal algorithm.
BUCKET	The precipitation gauge bucket
VWPCP1	Precipitation level indicated by precipitation gauge vibrating wire 1, the first sensor clockwise from true north on the precipitation gauge as viewed from above
VWPCP2	Precipitation level indicated by precipitation gauge vibrating wire 2, the second sensor clockwise from true north on the precipitation gauge as viewed from above
VWPCP3	Precipitation level indicated by precipitation gauge vibrating wire 3, the third sensor clockwise from true north on the precipitation gauge as viewed from above
WS2M	2 meter wind speed sensor
WSPD	Operational wind speed sensor
WDIR	Operational wind direction sensor
PRES	Barometric pressure sensor
SRAD	Solar radiation sensor
IRTT, IRTH	Infrared skin temperature sensor
RELH, TSLO	Relative humidity sensor with optional secondary air temperature sensor
DEWPNT	Dewpoint sensor
WTRVAP	Water vapor detection sensor
FW005, TS005	5-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under vegetation
FW010, TS010	10-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under vegetation
FW020, TS020	20-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under vegetation
FW051, TS051	51-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under sod

Parameter ID	Explanation
FW102, TS102	102-cm-deep soil moisture sensor: fraction of water per volume and soil temperature under sod
TPRECP	Precipitation gauge rim or catch funnel temperature sensor (these sensors are not tracked in the metadata database by serial number)
FLPHTR	Precipitation gauge rim or catch funnel heater flag value (this is not equipment that is tracked in the metadata database by serial number)
FLDOOR	Door flag value (door switches are not tracked in the metadata database by serial number)

Mass Install, Fix, or Move Form

1. Enter the 3- or 5-character station ID and circle "REMO" if a remote (weather) station, "RPTR" if a radio repeater site only, and "BASE" if a radio base station (LETS network access point). Enter the arrival and departure dates and times, as indicated by the station logger, if a remote station.
2. Enter the name of the maintenance contractor and the name(s) of the technician(s) performing the fix. The "ENTERED BY" and "DATABASE ENTRY" boxes are reserved for ISOS Office use.
3. Describe the problem as specifically and concisely as possible in the problem description area. If the problem was originally reported on a Trouble Ticket/Site Visit Form, transcribe the description exactly.
4. In every row corresponding to a sensor or equipment to which the problem or job applies, enter the old serial number, new serial number, a short description, with OSR, RPL, INI, RMV, or NAT, as appropriate, at the front, and the trouble ticket number, if one has been issued. The "DB Updated" column is reserved for ISOS Office use.
5. The blank rows at the bottom of Page 2 of the form can be used to enter information about new equipment that has not yet been included in the previous rows.

Sensor and Equipment Tags

Each sensor and unit of equipment listed on the trouble ticket forms must be accompanied by a tracking card when not installed at a station. The card should specify the sensor or equipment type, have fields for the serial number of the new sensor/unit, the serial number of the old sensor/unit replaced by the new sensor/unit, calibration coefficients of the new sensor, if applicable, the date the new sensor/unit was installed, the reason for replacement, any other pertinent information, and an area for notes. Examples are shown in Figures 10 and 11. A single tag can be used for both the new and old sensor/unit. It is simply transferred to the old sensor at the station where the replacement is made. This will ensure that the status of each uninstalled sensor/unit will be easily determined by anyone who handles it, and that calibration or repair facility people know how the sensor/unit should be processed, and will help them enter accurate information in the equipment tracking database.

FASTTHERM Calibration and Tracking Card
(*NOTE*- Resistor Pair # Matches Sensor #)

Serial Number_____

Final Cal Date_____

T-RMS_____

Date to Cabinet_____

****

Site Installed_____@Height_____m

Date/Time Installed_____

Tech(s) Installing_____

FSTHRM Replaced (S/N)_____

Reason for Removal: TT Rotation Other(Please Explain)

TT Number (if applicable)_____

Number of Months in Field_____

Please use below and back for comments, notes, etc.

PYRA Calibration and Tracking Card

Serial Number_____

Cal @ NRAD___/___/___to___/___/___.

Single Coeff_____

Poly Coeff C2_____

Poly Coeff C1_____

Poly Coeff C0_____

Resistor Value_____**Ω**

Date to Cabinet_____

****

Site Installed_____

Date/Time Installed_____

Tech(s) Installing_____

PYRA Removed (S/N)_____

Reason for Removal: TT Rotation Other(Please Explain)

TT Number (if applicable)_____

Number of Months in Field_____

Please use below and back for comments, notes, etc.

Figure 12. Sample instrument tracking cards.

CR10X -2M Calibration and Tracking Car d

Serial Number_____

NEW GOOD R E P A IRED

Repaired by: Mesonet CSI Other

Date Repaired_____

Date to Cabinet_____

****

Site Installed_____

Wire Panel Installed with (S/N)_____

Date/Time Installed_____

Tech(s) Installing_____

LOGGER Removed (S/N)_____

Wire Panel (S/N)* if Removed_____

Reason for Removal: TT Rotation Other(Please Explain)

TT Number (if applicable)_____

Number of Months in Field_____

(* If WP has no S/N, use logger S/N with 'WP' Prefix)

Please use below and back for comments, notes, etc.

P50 Radio Calibration and Tracking Card

Serial Number_____

NEW GOOD REPAIRED

Repair/Calib by Mesonet Delmmar Other

Date Repaired_____ Tech_____

2 CHANNEL RADIO

Channel #1 Frequency = 169.425

Channel #2 Frequency = 169.475

Date to Cabinet_____

****

Site Installed_____

Date/Time Installed_____

Tech(s) Installing_____

P50 Removed (S/N)_____

Reason for Removal: TT Rotation Other(Please Explain)

TT Number (if applicable)_____

Number of Months in Field_____

Please use below and back for comments, notes, etc.

Figure 13. Sample equipment tracking cards.

4.3 Serial Number Labeling of Sensors and Equipment

All sensors and all equipment listed in the NERON Station Metadata Form must have serial numbers assigned to them before they are installed so that they can be tracked accurately in the metadata database. However, if a sensor or unit of equipment is encountered in the field that does not have a serial number, the following convention should be used for assigning serial numbers to all equipment that do not have manufacturer-assigned serial numbers:

TTTYYDDD###

where,

TTT = sub-type of equipment (see Table 4). Do not use unless Table 4 shows an entry for the equipment type. Use leading zeros if the sub-type is less than 3 digits.
YY = last two digits of year that the number was assigned
DDD = Julian day that the number was assigned
= number in the series of the specific kind of sensor or equipment. Use leading zeros if the number is less than 3 digits

The ### part allows the assignment of serial numbers to multiple units of the same equipment or sensor type at the same time. Simply use 001 for the first, 002 for the second, etc. One sensor type or equipment type can have the same serial number as a different type of sensor or equipment, since each unit of equipment is always referred to in the metadata database by both its equipment type and serial number. The only requirement is that sensors or equipment of the same type have unique numbers. Equipment with different sub-types are considered different types and can be assigned identical YYDDD### portions of their serial numbers.

Table 4. Entries to use for the equipment sub-type portion when assigning a serial number to a sensor or unit of equipment.

Equipment Type	TTT
Solar Panel	Rating in watts
Battery	Amp-hour rating

Every sensor, except for barometers, should be labeled such that its serial number is printed on the cable end that is connected to the logger. The serial number should be printed on light-colored heat-shrink tubing, with an additional layer of clear heat-shrink tubing over the serial numbers to prevent them from being rubbed off or obscured. Sub-surface sensors that do not have their serial numbers stamped or etched on the sensor heads should have an additional label at the sensor end of the cable.

Every sensor or unit of equipment that is not installed inside an enclosure should have its serial number etched on its body, if possible. If the serial number is just printed on the body by the manufacturer or the manufacturer did not assign a serial number, then the installer should etch the serial number on an available non-sensitive surface. If etching is not possible, then the serial number should be printed on the cable, as described above. This will prevent problems

with tracking sensors and equipment whose serial numbers have become unreadable due to weathering.

Examples:
The following examples indicate the proper assignment of serial numbers to equipment, when assigned on June 7, 2005 (Julian day 158):

First 84 amp-hour battery of the day to be numbered – 08405158001
First 26 amp-hour battery of the day to be numbered – 02605158001
First 50W solar panel of the day to be numbered – 05005158001
Second 50W solar panel of the day to be numbered – 05005158002
First air temperature sensor of the day to be numbered – 05158001
Second air temperature sensor of the day to be numbered – 05158002
First precipitation gauge base of the day to be numbered – 05158001

4.4 Fix Deadlines and Prioritization

Problem fixes must be accomplished by the fix due date determined by the ISOS Office for each problem and will depend on the date the problem was confirmed and the priority of the problem. The prioritization of problems and routine tasks is described in Table 5 below.

The ISOS Office will report communication problems to the maintenance contractor by email – and phone for Category 1 Communication Problems – but the contractor is ultimately responsible for monitoring and following up on communication problems in their areas of responsibility using system reports and knowledge gathered while visiting stations in the field. The maintenance contractor should maintain a proactive role in the problem identification and resolution process, rather than waiting for specific reports from the ISOS Office.

If multiple tasks of differing priorities come due at the same time and the maintenance contractor cannot complete them all by the due time, then the tasks should be completed in order of priority.

Table 5. Ranking of equipment problems and routine tasks by priority, with fix deadlines.

Priority	Problem/Task	Time to Fix
1	Severe communications or equipment problem. Any problem that could cause permanent loss of data or that completely prevents real-time data collection, which isn't resolved by remote equipment resets, if two-way communication is possible, cannot be attributed to atmospheric phenomena, and cannot be traced to hardware or software problems with the non-NWS components of the communication network or to the data monitoring and collection facility.	2 business days
2	Empty a precipitation gauge bucket that is 75% or more full.	5 business days
3	Significant problem impacting real-time data collection. However, permanent data loss is unlikely.	5 business days
4	Trouble ticket that affects TAIR, PRECIP, BUCKET, VWPCP1, VWPCP2, VWPCP3, LOGG, BATV, BATVS, RADIO, RFMODM, RS232IF, VREG, VREGS, SOLRP, SOLRPS, ACTRAN, BATCHG, or FLDOOR.	10 business days
5	Communication problem that prevents real-time data collection for a moderate percentage of the time.	10 business days
6	Trouble ticket that affects WSPD, WDIR, WS2M, PRES, SRAD, IRTT/IRTH, RELH, DEWPNT, WTRVAP, FW005, FW010, FW020, FW051, FW102, TS005, TS010, TS020, TS051, or TS102.	20 business days
7	Developing communication problem that has not yet significantly affected real-time data collection.	20 business days
8	Scheduled maintenance – Spring maintenance is to be completed no later than two months following the "Remove Mixture Date" given in Table 11 on Page 74 for each climate division. Fall maintenance is to be completed no later than the "Add Mixture Date" given in Table 11 on Page 74 for each climate division. Scheduled maintenance at repeaters and bases must be completed once per year on a schedule at the discretion of the maintenance contractor.	See problem/ task description
9	Trouble ticket that affects **only** TSLO, WIRPAN, PRTMOD, MUX, SERSRV, ETHHUB, ROUTER, SERADS, SERADH, PDA, UPS, SRGSUP, TPS, TPRECP, or FLPHTR. If a problem with any of these were to adversely affect any higher-priority item, then the problem takes that higher priority.	30 business days
10	Submit electronic documentation and photos following a maintenance visit or trouble ticket fix to the ISOS Office	5 business days
11	Low priority task specified at the discretion of the network manager, QA manager, or lead operator	Next site visit (do not schedule a special visit)

4.5 Spare Inventory

To avoid unnecessary travel to fix unexpected problems encountered while away from home base, each technician should carry enough spare sensors and equipment to completely replace all of the sensors and electrical equipment at two remote stations, two repeaters, and two base stations. The repeater and base station requirement only applies to areas with LETS communication equipment. The spare inventory should cover every possible station configuration and should include at least one station's worth of each type of data logger, multiplexer, communication radio, antenna cable, antenna, battery, solar panel, voltage regulator, surge suppressor, and AC transformer.

In addition, each technician should carry at least one complete set of bolts, screws, nuts, and padlocks, if applicable, and a set of grounding hardware, including 4 AWG copper wire, lightning rod cable, and grounding clamps and acorns for each type and configuration of station.

4.6 Fix Procedures

4.6.1 Sensors

4.6.1.1 Air Temperature, Relative Humidity, and Dewpoint Sensors

1. Verify that the sensor wires and resistor leads are securely clamped by the wire terminals in the logger enclosure.
2. Verify that there are no obstructions to airflow through the radiation shield or over the sensor head. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11, and remove any obstructions and clean any dirt found,.

3. Check the sensor cable for wear, damage, or cuts, and replace the sensor if any are found.
4. If the problem cannot be repaired or the above checks do not uncover a problem, replace the sensor.

4.6.1.2 GEONOR Precipitation Gauge

1. Verify that the sensor wires are securely clamped by the wire terminals in the logger enclosure, at the terminal strip mounted to the rim of the gauge frame inside the gauge, and at each of the three green vibrating wire junction boxes inside the gauge.
2. Verify that none of the wires inside the gauge are or could come into contact with the bucket, vibrating wire sensors, or the bucket support dish. Secure any loose wires to the gauge frame with cable ties or with electrical or other water-proof tape.
3. If the problem is an unexplained reduction in precipitation amount reported by the logger, verify that the bucket does not have a leak. Replace it and recalibrate the gauge, as described in Section 3.1.9.3, on Page 21, Calibration, if so.
4. When the logger excites the vibrating wire sensors, verify that each wire hums audibly. Measure the voltages across the Out + and Out - terminals, across the VWG + and VWG - terminals, and across the VWG + and Ground terminals at the junction box, at the gauge terminal strip, and across the A and B terminals, across the D and E terminals, and across the C and E terminals at the TH-501 hybrid interface corresponding to each vibrating wire that does not hum when the vibrating wires should be excited. Replace any wires, cables, junction boxes, or hybrid interfaces that are confirmed faulty due to lack of voltage.
5. Replace any vibrating wire sensors that are still inoperative after replacing any faulty parts.
6. If any vibrating wire sensors were replaced, or the problem has not been diagnosed, calibrate the gauge, as described in Section 3.1.9.3, on Page 21, Calibration.

4.6.1.3 GEONOR Precipitation Gauge Rim Heater

(TO BE INSERTED)

4.6.1.4 2-Meter Wind Speed

1. Verify that the sensor wires are securely clamped by the wire terminals in the logger enclosure.
2. Verify that there are no obstructions, webs, or dirt affecting the cups. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11, and remove any obstructions and clean any dirt found,.

3. Check for bearing noise that indicates the presence of dirt, which introduces excessive friction. Listen for a grinding or rattling sound. A clean hissing sound after a sensor has been deployed for a number of months is normal and does not qualify as "noisy."
4. Check the sensor cable for wear, damage, or cuts, and replace the sensor or repair the cable if any are found.
5. If the problem cannot be repaired or the above checks do not uncover a problem, replace the sensor.

4.6.1.5 Operational Wind Sensor Speed

1. Verify that the sensor wires are securely clamped by the wire terminals in the logger enclosure and at the junction box at the sensor end.
2. Verify that there are no obstructions, webs, or dirt affecting the propeller. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11, and remove any obstructions and clean any dirt found.

3. Check for bearing noise in the propeller mechanism that indicates the presence of dirt, which introduces excessive friction. Listen for a grinding or rattling sound. A clean hissing sound after a sensor has been deployed for a number of months is normal and does not qualify as "noisy."
4. Check the sensor cable for wear, damage, or cuts, and replace the sensor or repair the cable if any are found.
5. If the problem cannot be repaired or the above checks do not uncover a problem, replace the propeller section of the sensor.
6. If replacing the propeller does not solve the problem, replace the entire prop-vane sensor.

4.6.1.6 Operational Wind Sensor Direction

1. Verify that the sensor wires are securely clamped by the wire terminals in the logger enclosure and at the junction box at the sensor end.
2. Verify that there are no obstructions or webs affecting the vane. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11, and remove any obstructions found.

3. Check the sensor cable for wear, damage, or cuts, and replace the sensor or repair the cable if any are found.
4. Check the alignment of the vane. Use a bracket to immobilize the vane in a direction at least 10 degrees off of true north and use a compass accurate to one degree, taking magnetic variation into account, to check, and, if necessary, adjust the alignment.
5. If the problem cannot be repaired or the above checks do not uncover a problem, replace the direction potentiometer section of the sensor.

4.6.1.7 Barometer

1. Verify that the sensor wires are securely clamped by the wire terminals in the logger enclosure.
2. Verify that there are no obstructions blocking the sensor inlet tube. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11, on Page 7, and remove any obstructions. Replace the inlet tube if the old one cannot be cleared completely or if it is worn or cracked.

3. Check the sensor cable for wear, damage, or cuts, and replace the sensor or repair the cable if any are found.
4. Run a field intercomparison with a reference barometer, if possible.
5. If tightening loose wire connections or clearing the inlet tube makes a noticeable difference in the BARO input location reading on the data logger, the intercomparison indicates a 5% or less error, and it isn't clear that the problem has been fixed, then call the QA Manager or Systems Integration Manager for guidance. Replacement may not be necessary.
6. If the problem cannot be repaired or the above checks do not uncover a problem, replace the sensor.

4.6.1.8 Pyranometer

1. Inspect the pyranometer level and check for bird droppings, debris, or dust and note anything out of the ordinary about the sensor, cable, or connections to the data logger on the site visitation report, pass form, or trouble ticket. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11.

2. If the pyranometer (SRAD) input location reading on the data logger is negative, and a temperature and relative humidity (T&RH) sensor is installed, check the T&RH switch by disconnecting the T&RH's yellow wire from the data logger. If the RELH input location reading on the data logger is not 0.0000, then the T&RH switch is faulty and causing SRAD to indicate a negative number; replace the T&RH and recheck the SRAD reading.
3. Run a field intercomparison with a reference pyranometer, if possible.
4. If tightening loose wire connections, cleaning the pyranometer, or replacing the T&RH makes a noticeable difference in the SRAD input location reading on the data logger, the intercomparison indicates a 5% or less error, and it isn't clear that the problem has been fixed, then call the QA Manager or Systems Integration Manager for guidance. Replacement may not be necessary.
5. If replacing the pyranometer, put the protective cap from the new pyranometer on the old pyranometer, unwire it from the data logger, and remove it by loosening the allen set screw on the mounting plate.

   NOTE: It is important not to let anything except paper towels moistened with water touch the white translucent lens of the pyranometer because even small scratches can change the pyranometer's calibration.
6. Secure the new pyranometer to the mounting plate by tightening the set screw, coil up the excess cable, and wire it to the data logger.
7. Put a cap on the pyranometer that doesn't let any light through – wrapping black electrical tape around one of the red protective caps that comes with pyranometers works well – and check its input location on the data logger to verify that the reading is zero.
8. If the T&RH switch is good and the new pyranometer reading is slightly negative or positive – within 1.0 W/m^2 of 0 – then verify that the pyranometer's analog ground wire is connected to an analog ground port on the data logger near the analog port to which the analog data wire from the pyranometer is connected, and make a note of the reading on the trouble ticket.
9. Re-seal the data logger enclosure cable port with clay, if applicable.
10. Call the NWS data collection facility with the following information:
    1. Old pyranometer serial number
    2. New pyranometer serial number
    3. Site ID
    4. Time of fix as written on the trouble ticket
11. Note the name of the operator and the time of the call on the trouble ticket.

4.6.1.9 Skin Temperature

1. Verify that the sensor wires are securely clamped by the wire terminals in the logger enclosure.
2. Verify that the sensor is level and that there are no obstructions or dirt on or blocking the sensor lens and that there are no foreign objects on the ground below the sensor that might

alter the amount of infrared radiation reaching the sensor. Document any significant findings photographically, as described in Section 3.1.3,

Photographic Documentation, on Page 11, and remove any obstructions or foreign objects and clean any dirt found on the lens with a cotton swab dipped in methanol.

3. Check the sensor cable for wear, damage, or cuts, and replace the sensor if any are found.
4. If the problem cannot be repaired or the above checks do not uncover a problem, replace the sensor.

4.6.1.10 Soil Moisture/Temperature

NOTE: The soil moisture/temperature probe should be handled carefully to avoid bending the tines or nicking or scratching the sensor head from which the tines protrude. Bending the tines will cause erroneous readings, since they must be at a set distance from each other to obtain accurate soil capacitance and inductance readings. Deep nicks or scratches in the sensor head could expose the electronics to moisture, which would permanently damage the sensor.

1. Locate and mark the hole locations at the positions shown in Figures 1, 3, and 5 and in Table 6 below.

Table 6. Soil moisture/temperature probe installation hole locations relative to the center of the mast or tower.

	10x16 plot		16x20 plot		20x40 plot	
Sensor Depth (in.)	**Position E-W (ft)**	**Position N-S (ft)**	**Position E-W (ft)**	**Position N-S (ft)**	**Position E-W (ft)**	**Position N-S (ft)**
2	11 E	3 S	11 E	6 S	15 E	3 S
4	9 E	3 S	9 E	6 S	13 E	3 S
8	7 E	3 S	7 E	6 S	11 E	3 S
20	5 E	3 S	5 E	6 S	9 E	3 S
40	3 E	3 S	3 E	6 S	7 E	3 S

2. Remove and set aside a 10-inch diameter sod plug for each hole, being careful to keep the sod as intact as possible to recover the hole when installation is complete.
3. Excavate the hole to a depth 10 inches greater than the sensor depth. This will provide a collection area below the actual sensor for any water that seeps down the inner surface of the hole. Use a gas-powered auger (10-inch diameter) for 20- and 40-inch sensors. Post hole diggers may be used for 2-, 4-, and 8-inch sensors. Collect the excavated soil on a tarp, preserving the order of removal so that the soil stratification can be restored as much as possible when refilling the hole.
4. Take an approximately 4-cubic-inch soil sample at the sensor depth from the west, east, and/or north sides of the hole and place it in a plastic zipper-seal bag; label the station, depth, and date on the bag. Submit it to (TO BE INSERTED) for analysis.

5. Install conduit extending from the tower to just below sensor depth at the north side of the installation hole. Extend the conduit at least one foot above ground level at the tower end to prevent string trimmer or lawnmower damage to the cables. For 2-inch, 4-inch, and 8-inch sensors, cut and install a length of wire braid material to extend from the sensor to a few inches inside the end of the conduit to discourage burrowing animals from chewing through the cable. Feed the sensor cable through the conduit and push the metal braid a few inches into the conduit. Bury the conduit so that its top is at or below ground level, to allow a mower to pass over it.
6. Use a putty knife or paint scraper to smooth out the vertical surface on the south side of the hole at the sensor depth and to make it as vertical as possible.
7. Use a measuring stick and a straight edge placed horizontally at ground level at the top of the hole to determine the exact depth at which to install the sensor.
8. Insert the sensor horizontally into the soil, pointing south, at the proper depth. Do not move the sensor from side-to-side or wiggle it as it is inserted, as this could bend the tines and will form air pockets that will cause erroneous readings. In hard or rocky soils, use the Hydra Probe Jig to make pilot holes for the tines.
9. Route the sensor cable so that a drip loop is formed below the sensor.

Figure 14. Vertical cross-section showing hole dimensions and conduit, cable, and sensor placement. (TO BE INSERTED)

12. Wire the sensor to the data logger and perform a soil moisture cycle to check its operation. Initiate the cycle by entering (TO BE INSERTED) via the keypad. The cycle will occur during the next complete (TO BE INSERTED) second execution interval.
13. Backfill the installation hole with excavated soil in reverse of the order it was removed to preserve the soil stratification, making sure to tamp the soil well. Add water to help the soil settle.
14. Place a plot marker 12 inches due north of the hole center and mark the depth of the sensor on the top of the marker with a paint pen.
15. Replace the sod plug and repair the cut between the sod plug and the surrounding soil.

4.6.2 Electronic Equipment

4.6.2.1 Data Logger

(TO BE INSERTED)

4.6.2.2 Multiplexer

(TO BE INSERTED)

4.6.2.3 Raven CDMA Modem

1. Verify that both the logger and CDMA modem have power. The PWR LED on the modem should be lit.
2. Use a cable tester or continuity tester to test the cables connecting the logger and modem, modem and radio, or logger and radio, as applicable, if they might be causing the problem.
3. Troubleshoot the power system, as described in Section 4.6.3.1 on Page 62, if a solar system, and in Section 4.6.3.2 on Page 62, if an AC system.
4. Verify that the modem's Chan, Link, and Reg LEDs are lit and that the RSSI LED is blinking or lit. See Table 7 below for the meaning of each LED.

Table 7. Raven CDMA modem LED indications (from AirLink Communications Raven and PinPoint CDMA User Guide Version 1.12).

LED Label	Meaning
Chan	Flashing: searching for a channel On: found a channel
Link	On: 1x or CDMA service is available on this channel
Reg	On: PPP link is established on CDMA network and have an IP address
RSSI	Off: signal strength < -100 dBm Blinking every 1200 ms: signal strength -99 to -90 dBm Blinking every 600 ms: signal strength -89 to -80 dBm Blinking every 300 ms: signal strength -79 to -70 dBm On: signal strength ≥ -69 dBm
TxRx	On if transmitting or receiving
ERR	(not used)
PWR	On if power on

5. If the Chan and Link LEDs are lit but the Reg LED is not, verify that the modem is properly configured.
6. If the Chan LED is flashing, the Link LED is off, or the RSSI LED is off or blinking at only 1200 ms intervals, then check all of the coaxial cable connectors for security, damage, corrosion, or bent center pins; check the antenna for damage; and check the entire length of coaxial cable for wear, damage, or cuts. Replace or repair damaged components and replace

or clean corroded parts. In addition, check that there are no nearby metal objects above, below, or to either side of the antenna.

7. Verify that the antenna is pointing in the proper direction and is the proper type for the RF path.
8. If the problem still has not been corrected, then install and configure a known good modem. Replace the old modem if the problem persists.
9. Check to see if the CDMA network is experiencing an outage that could be causing the problem.

4.6.2.4 GOES Transmitter

NOTE: When troubleshooting, if a piece of equipment is replaced that doesn't fix the problem and isn't known to need repair, then return the original piece of equipment to the system to allow the problem to be localized and fixed without multiple return trips and to prevent returning working equipment for needless testing.

Procedure

1. Verify that all remote station equipment (logger and GOES transmitter) has power and is turned on.
2. Troubleshoot the power system, as described in Section 4.6.3.1 on Page 62, if a solar system, and in Section 4.6.3.2 on Page 62, if an AC system.
3. Data logger:
    a. Verify that the data logger has power.
    b. Connect to the logger with a laptop or keypad display and view current data to verify that it is operating properly.
4. Transmitter:
    a. Verify that the GPS antenna is connected. The transmitter will not transmit without a valid GPS fix.
    b. Verify that the transmitter has a GPS fix and hasn't logged any errors. Investigate all errors logged.
    c. Verify that the transmitter is configured to transmit in Pseudo Binary mode and that the correct NESDIS ID, window, interval, transmit time (offset), channel, and baud values are programmed.
    d. If a Campbell transmitter, verify that it is configured with the CSI port, rather than the SDI-12 port, as the active port.
    e. Use a cable tester or continuity tester to test the cable connecting the logger and the transmitter.
5. Antenna System:
    a. Perform an SWR test, as described in Section 4.6.2.7, on Page 60, Radio-Antenna System SWR Test.

4.6.2.5 Initial LETS Communication System Troubleshooting

The following are procedures that will be performed by data monitoring facility personnel. They are included in this document for the information of the maintenance technicians.

1. Verify that the correct RF ID's for the base station, repeater, and remote station are entered in the communication server.
2. Try to eliminate the possibility of a problem with the base station:
    a. Often, problems with base communications can be corrected by first downloading new configuration information, and then performing soft and hard resets, including cycling the power, as necessary.
    b. If the base station serves stations that don't have communication problems, then the base is probably operating properly.
    c. If the base station can send clock checks to other remote stations through a backup link, then the base is probably operating properly.
    d. If RF tests from the base and a working repeater or remote station or from another base to the suspect base indicate that both the base and the nearest station can receive from each other well, then the base is probably operating properly. However, poor RF test statistics for base reception or nearest station reception can indicate a possible problem with the base's radio, antenna coaxial cable, or antenna. Keep in mind, though, that poor RF test statistics may be caused by poor atmospheric conditions or an RF path over a backup link that is marginal due to distance or terrain.
    e. If clock checks can be sent to the base station, then everything except the connection between the radio and the RF modem, radio, antenna coaxial cable, and/or antenna is probably operating properly.
    f. If it is only possible to telnet to the serial server at the base station, then everything except the serial server RS-232 port, base RS-232 interface, RF modem, radio, antenna coaxial cable, antenna, and the cables connecting them, is probably operating properly.
    g. If it is possible to ping the serial server at the base station, then everything except the serial server, base RS-232 interface, RF modem, radio, coax, antenna, and the cables connecting them, is probably operating properly.
    h. If it is possible to ping the LETS PC at the base station location, then everything except the connection between the serial server and the ethernet hub, serial server, base RS-232 interface, RF modem, radio, coax, antenna, and the cables connecting them, is probably operating properly.
    i. If it is not possible to ping the LETS PC at the base station location or the serial server, and the LETS network is not down, then the ethernet hub or the connection between the hub and LETS may be faulty. It is also possible that there are problems with any or all of the other base station components.
2. Try to eliminate the possibility of a problem with any repeaters:
    a. If a repeater serves stations that don't have communication problems, then the repeater is probably operating properly.

b. If a repeater can send clock checks to other stations – through a backup link, if available and necessary – then the repeater is probably operating properly.

c. If RF tests through a repeater to other stations – through a backup link, if available and necessary – indicate that both the repeater and at least one of the stations it transmits to can receive well, then the repeater is probably operating properly. However, poor RF test statistics for repeater reception or nearest station reception can indicate a possible problem with the repeater's radio, coax, or antenna. Keep in mind, though, that poor RF test statistics may be caused by poor atmospheric conditions or a marginal RF path over a backup link due to distance or terrain.

d. If all of the stations served by a repeater are experiencing a communication outage, and if RF tests to the repeater from its base or another base through a backup link always fail, then it is possible that there are problems with any or all of the repeater components.

3. Try to eliminate the possibility of a problem with the remote station(s):

   a. If a different base is able to set the clock at a remote station through a backup link, then the remote station is probably operating properly.

   b. If the primary base is able to send a good RF test to the remote station or if a backup base with a possibly marginal link is able to send any kind of RF test to the remote station, then every communication component except the data logger, the cable between the logger and the RF modem, and the logger communication port on the RF modem is probably operating properly.

4. If the problem cannot be resolved remotely by calling LETS personnel, then visit the station(s) most likely to be causing the problem. (Refer to the appropriate procedure: base station, repeater, or remote station troubleshooting)

4.6.2.6 LETS Remote Station Communication Equipment

Use the **NOTE:** When troubleshooting, if a piece of equipment is replaced that doesn't fix the problem and isn't known to need repair, then return the original piece of equipment to the system to allow the problem to be localized and fixed without multiple return trips and to prevent returning working equipment for needless testing.

Procedure

6. Verify that all remote station equipment (logger and GOES transmitter) has power and is turned on.
7. Troubleshoot the power system, as described in Section 4.6.3.1 on Page 62, if a solar system, and in Section 4.6.3.2 on Page 62, if an AC system.
8. Data logger:
    a. Verify that the data logger has power.
    b. Connect to the logger with a laptop or keypad display and view current data to verify that it is operating properly.
9. Transmitter:
    a. Verify that the GPS antenna is connected. The transmitter will not transmit without a valid GPS fix.
    b. Verify that the transmitter has a GPS fix and hasn't logged any errors. Investigate all errors logged.
    c. Verify that the transmitter is configured to transmit in Pseudo Binary mode and that the correct NESDIS ID, window, interval, transmit time (offset), channel, and baud values are programmed.
    d. If a Campbell transmitter, verify that it is configured with the CSI port, rather than the SDI-12 port, as the active port.
    e. Use a cable tester or continuity tester to test the cable connecting the logger and the transmitter.
10. Antenna System:
    b. Perform an SWR test, as described in Section 4.6.2.7, on Page 60, Radio-Antenna System SWR Test.

Initial LETS Communication System Troubleshooting procedure in Section 0 on Page 55 as a guide to determine which remote station component is most likely to be causing the problem and troubleshoot that component before moving on to other components.

NOTE: When troubleshooting, if a piece of equipment is replaced that doesn't fix the problem and isn't known to need repair, then return the original piece of equipment to the system to allow the problem to be localized and fixed without multiple return trips and to prevent returning working equipment for needless testing.

Procedure

1. Verify that all remote station equipment (logger, RF modem, radio) has power and is turned on.
2. Use a cable tester or continuity tester to test the cables connecting the logger and modem, modem and radio, or logger and radio, as applicable, if they might be causing the problem.
3. Troubleshoot the power system, as described in Section 4.6.3.1 on Page 62, if a solar system, and in Section 4.6.3.2 on Page 62, if an AC system.
4. Data logger:
    a. Verify that the data logger has power.
    b. Connect to the logger with a laptop or keypad display and view current data to verify that it is operating properly.
5. Radio:
    a. Verify that the rainbow cable securely connects the RF modem and the radio. The rainbow cable connector should be turned clockwise as far as it will go at the radio end, and there should be a cable tie around the rainbow cable connector and the antenna connector to ensure a positive connection.
    b. Verify that the Carrier Detect LED on the RF modem flashes on for one second, off for one second, and on for one second when the RF modem's blue cable is initially plugged in to the data logger. Other flashing patterns indicate problems with the PROM or the modem. If replacing the PROM with the proper version (see **c.**) doesn't fix the problem, then replace the RF modem.
    c. Verify that the RF modem has a version 4 PROM (the label on the chip will have two numbers printed on it: 6873 and 04 – a version 8 PROM must be used if the station's RF ID is greater than 128) and that the PROM and memory chips are pushed in securely (the memory chip is located next to the PROM and is the same size).
    d. Verify that the dip switches on the RF modem are set correctly to correspond to the base station's RF ID. (See Setting RF95T RF ID Reference.)
    e. Verify that the radio is set to the proper frequency.
6. Antenna System:
    c. Verify that the radio is turned on and that the squelch is set properly, if applicable.
    d. Verify that the Carrier Detect LED on the RF modem lights when the radio's squelch is broken by turning the squelch knob counter-clockwise or when the radio receives a signal. If the LED does not light, there could be a problem with the RF modem, the cable connecting it to the radio, or the cable ports on either the RF modem or the radio.
    e. Perform an SWR test, as described in Section 4.6.2.7, on Page 60, Radio-Antenna System SWR Test.
    f. If a solar-powered site, and the station has periodic outages during the mid-day hours but troubleshooting hasn't found any problems, then high voltage may be reducing the radio's receiver sensitivity when the solar panel is producing peak power. To solve the problem, install a voltage regulator between the radio and the power supply.

4.6.2.7 Radio-Antenna System SWR Test

1. Use an RF power meter placed between the transmitter and the antenna cable at sites with GOES or LETS radios. Verify that the meter is rated or set for the frequency range of the transmitter. Measure and record the forward and reflected power in the "Arrival" row of the RF power table on the maintenance or site visit form. If any changes are made to the communication system during the visit, then perform and record the results of the final RF power test in the "Departure" row.

   Table 8 below lists forward power (W_f) values and the corresponding reflected power (W_r) values for standing wave ratios (SWR) of 1.5:1, 2:1, and 3:1. For optimum communication quality, the SWR should be less than 1.5:1, though a value less than 2:1 is acceptable. If the SWR is 2:1 or greater but less than 3:1, then there is a problem that should be fixed soon, though the radio can continue to operate normally. If the SWR is 3:1 or greater, then the radio can be damaged and should be turned off immediately until the problem is fixed.

   Table 8. Forward power (W_f) and corresponding reflected power (W_r) values for standing wave ratios of 1.5:1, 2:1, and 3:1 for radio-antenna systems.

W_f (W)	W_r 1.5:1 SWR (W)	W_r 2:1 SWR (W)	W_r 3:1 SWR (W)
10.0	0.40	1.11	2.50
9.0	0.36	1.00	2.25
8.0	0.32	0.89	2.00
7.0	0.28	0.78	1.75
6.0	0.24	0.67	1.50
5.0	0.20	0.56	1.25
4.0	0.16	0.44	1.00
3.0	0.12	0.33	0.75
2.0	0.08	0.22	0.50
1.5	0.06	0.17	0.38
1.0	0.04	0.11	0.25
0.8	0.03	0.09	0.20
0.6	0.02	0.07	0.15
0.4	0.02	0.04	0.10
0.2	0.01	0.02	0.05

2. If the SWR is too high, check all of the coaxial cable connectors for security, damage, corrosion, or bent center pins; check the antenna for damage; and check the entire length of coaxial cable for wear, damage, or cuts. Any of these conditions could attenuate RF signal power at the antenna and/or reflect power toward the transmitter, increasing the standing wave ratio and reducing transmission power further. Replace or repair damaged components and replace or clean corroded parts. In addition, check that there are no nearby metal objects above, below, or to either side of the antenna.
3. Once SWR has been minimized and is in the acceptable range, if the forward power is much lower than the radio's rated transmit power, then the radio should be replaced.

4. Verify that the antenna is pointing in the proper direction and is the proper type for the RF path.

4.6.2.8 PDA/Wireless RS-232

(TO BE INSERTED)

4.6.3 Power System

4.6.3.1 Solar

1. Verify that all cables connecting the charging source, regulator (if applicable), battery, data logger, modem, radio, and antenna are undamaged and plugged in to their proper connectors securely.
2. If the fuse between the battery and the logger enclosure is blown, locate and fix the cause, if any can be found, before replacing the fuse.
3. Verify that all power connections are free of corrosion and tight, and verify that all power wires are sound by checking for voltage drops across them with power applied or by checking resistance across them when disconnected. Replace or repair all wires that have high resistances, high voltage drops, or that cause voltage to fluctuate intermittently.
4. Verify that the voltage across the wires from the solar panel(s) when disconnected from the regulator is about 20 V in bright sunlight – the voltage will be lower or zero when the sun is low, below the horizon, or obscured by thick clouds, though it should be greater than 13 V in cloudy conditions. If a solar panel's voltage output is too low, verify that it is clean and undamaged and check its cable for damage.
5. Verify that the battery is good. Remove the fuse between the regulator and the battery. The potential across the battery terminals should not fall below 12 V when the radio is keyed continuously for a few seconds. Replace the battery if it does not pass this test or if it has any cracks, leaks, or bulging or concave sides. If the battery is not old and passes the visual inspection, but has a low voltage output and hasn't had an unusually large current drain for an extended period of time recently, then the regulator should be replaced, too.
6. If the voltage across the wires from the solar panel is at least 18 V when disconnected from the regulator, then reconnect the solar panel to the regulator and remove the fuse between the regulator and the battery. If the output voltage from the regulator at the "BATT" terminals is 5 V or less, then replace the regulator – this test cannot be performed if the solar panel voltage is much less than 18 V when disconnected from the regulator. Replace the regulator if its temperature sensor or sensor cable is damaged.

4.6.3.2 AC

5 Use of the Instrument Database

The instrument database is used to store and organize site metadata and to track sensors, equipment, and problems with equipment in the network. The database web interface is used to enter newly-acquired sensors and equipment, check sensors and equipment into and out of storage facilities, track sensor residence times (the number of months a sensor has resided at a specific site) for the purpose of scheduling sensor rotations, track problems in the network, and track recurring problems at specific sites or with specific sensors, and enter and track sensor calibration coefficients.

The database may be accessed at:

http://xwww.ncm.noaa.gov/admin/databases/metadb/

A username and password are required to log on.

The sections beginning with 5.2 describe how to perform some of the more commonly-used database tasks. In addition, the database has many more functions that may be useful. To learn more about them, click on the *Documentation* menu at the top of the web page.

5.1 Duties of Database Users

Each individual unit of equipment listed on the metadata form must be tracked in the instrument database by serial number from acquisition to decommissioning for use in NERON. Therefore, each person who handles tracked equipment by receiving it, moving it from one facility or station to another, calibrating it, or disposing of it when its useful life is complete must document each change in a unit of equipment's location, calibration, or operational status using the database web interface. The following subsections list the database tasks for which each type of user is responsible. The duties marked with **+** bullets can only be performed by lead technicians and calibration lab managers.

5.1.1 Field and Lead Technicians

- Check equipment into and out of their home base's spare inventory
- Track trouble tickets issued for the stations under their responsibility to ensure that all problems are fixed within the time limits listed in Table 5 on Page 42.
- Track sensor residence times for the stations under their responsibility to ensure that all sensors are rotated at the intervals specified in Section 3.1.11, Sensor Rotation Intervals, on Page 24.

+ Insert new inventory received directly from an equipment vendor

+ Decommission equipment that is no longer usable

5.1.2 Calibration Lab Technicians and Managers

- Enter calibration coefficients associated with specific sensors
- Check equipment into and out of the calibration lab's inventory
- Track recurring problems with specific sensors

+ Insert new inventory received directly from an equipment vendor

+ Decommission equipment that is no longer usable

5.1.3 Inventory Managers

- Check equipment into and out of the managed facility's inventory
- Track recurring problems with specific sensors and equipment
- Insert new inventory received directly from an equipment vendor
- Decommission equipment that is no longer usable

5.2 Viewing Site Metadata

1. Click on the *Network* menu at the top of the page and select *Site Summary*.
2. Select the network and site from the drop-down menus at the top left corner of the pane that appears.

5.3 Inserting New Equipment and Decommissioning Equipment

1. Click on the *Equipment* menu at the top of the page and select *Insert Inventory*.

5.4 Checking Equipment In and Out

Check In should be used for equipment being returned from the field and for equipment received from another facility that has already been inserted in the database. Check Out should be used for equipment being removed from a facility's inventory, either to install at a station, to replenish spare inventory in a technician vehicle, or to ship equipment to another facility.

1. Click on the *Equiment* menu at the top of the page and select *CheckIn* or *CheckOut*, as applicable. If checking multiple items in or out at once, select *MassCheckIn* or *MassCheckOut*.
2. Enter all of the information requested and click the *Insert* button. If checking equipment out for a technician to install at a station or for spare vehicle inventory, enter the name of the technician in the *Location* field. If shipping equipment to another facility, enter the name of the person shipping the equipment in the *Location* field.

5.5 Entering Calibration Coefficients

(TO BE INSERTED)

5.6 Tracking Problems

It is possible to track problems by any of a number of criteria. For example, one could search for all problems with a given parameter (sensor or equipment type) at a given site to look for a pattern of problems specific to that site. Alternatively, a calibration lab technician could search for all problems with a given sensor at all sites at which it has ever been installed to look for a pattern of problems specific to that sensor.

1. Click on the *Ticket* menu at the top of the page and select *Search*.
2. Enter all desired search criteria and click the *Search* button.

5.7 Tracking Residence Times

1. Click on the *Equipment* menu at the top of the page and select *Search*.
2. Select the sensor or equipment of interest from the *Eqtype* drop-down menu.
3. Click on the *Residence Time* tab below the search criteria.
4. Select the technician or network and a specific site or *All Sites*.
5. Click the *Search* button.

5.8 Tracking Equipment Locations

1. Click on the *Equipment* menu at the top of the page and select *Search*.
2. Enter all desired search criteria.
3. Click on the *Location* tab below the search criteria and enter any additional search criteria desired.
4. Click the Search button.

6 Use of the Metadata Form

The metadata form should be used to report initial installations and moves of stations, as well as any changes in station metadata beyond maintenance and equipment changes accounted for in the maintenance and trouble ticket forms.

The following is an explanation of how to enter information in all sections of the metadata form.

6.1 Header

The header should be filled out completely any time the metadata form is used. If an update, enter only the information that has changed in the sections after the header.

- Check the "Initial Installation" box if this is the first time the station is being installed. Check the "Move" box if an existing station is being moved to a new location nearby. Check the "Update" box if metadata is being updated for an existing station that is not being moved. When moving a site, use the Weather Reference Network Trouble-Ticket Form for Mass Installs, Fixes, or Moves to document the serial numbers of all equipment removed. Then use the metadata form to document all equipment installed at the new location.
- Enter the 3- or 5-character station ID, the full station name, and circle the station type (REMO for a remote weather station, RPTR for a communication repeater, or BASE for a communication base station).
- Enter the effective date and time of the change in coordinated universal time (UTC). In the case of an installation or move, this is the time that the installation or move is totally complete and the station has been verified operational.

6.2 Site Information

- Enter the latitude and longitude, as measured from the center of the site plot, using a GPS receiver with Wide-Area Augmentation System (WAAS) or differential capability, *in fractional degrees to 5 decimal places*. Enter the elevation, as measured by the same GPS receiver. Take a photo of the GPS display, formatted as described in Section 3.1.3,

Photographic Documentation, on Page 11.

- Enter the manufacturer and model number of the GPS used to determine latitude and longitude in the "LAT/LON SOURCE" box and the manufacturer and model number of the device used to determine the elevation in the "ELEV SOURCE" box. If a single GPS receiver is used for both lat/lon and elevation, enter the same information in both boxes. Enter the horizontal and vertical coordinate reference datums used by the GPS. The horizontal reference datum used must be NAD83 (North American Datum of 1983) or later, and the vertical reference datum used must be NAVD88 (North American Vertical Datum of 1988) or later. It is important to note the datum used, because errors of up to 150 feet can be introduced by assuming the wrong datum.
- Enter the offset of local standard time from Coordinated Universal Time (UTC), the magnetic declination (the number of degrees that a compass needle points east or west of true north; be sure to include "W" or "E," as appropriate, after the number).
- Enter the state, county, climate division, the three-letter ID of the weather forecast office (WFO) in whose county warning area (CWA) the site is located, and the government property ID (if applicable).
- Circle the plot size, indicate whether a fence is installed around the perimeter of the plot, describe the type of fence, indicate whether the station is solar- or AC-powered, whether an enclosure heater is installed, and enter the number of ground rods, ground plates, and/or grounding mesh matrices installed.

6.3 Basic Sensors Installed

- Enter the manufacturer, model number, and serial numbers of the air temperature sensor, and the precipitation gauge base (the frame holding the vibrating wire sensors). In addition, enter the serial numbers of the precipitation gauge bucket and vibrating wire sensors, if a GEONOR T-200 gauge. Enter "N/A" in the manufacturer field of all sensors that are not installed, for initial installations and moves.
- Enter the calibration coefficients of each vibrating wire sensor, if a GEONOR T-200 gauge.
- Circle the precipitation gauge type, enter the height of the gauge inlet, indicate whether a precipitation gauge heater is installed, and enter the manufacturer and model number of the heater.
- Enter the types of antifreeze and oil initially put in the gauge, and enter the amount of antifreeze added. This applies only to weighing-bucket-type gauges. (It is not necessary to submit a new metadata form if the antifreeze type or amount or the oil type changes.)

6.4 Enhanced Sensors Installed

Enter the manufacturer, model number, and serial number of each enhanced sensor installed. See Table 3 on Page 34 for an explanation of the sensor parameter IDs. Enter "N/A" in the manufacturer field of all sensors that are not installed, for initial installations and moves.

6.5 Equipment Installed

Enter the manufacturer, model number, and serial number of each unit of equipment installed. See Table 3 above for an explanation of the Equipment parameter IDs. Enter "N/A" in the manufacturer field of all equipment that is not installed, for initial installations and moves.

- LOGG. In addition, enter the logger operating system or firmware version, the program or setup name (if this file is given a unique name for each site before it is uploaded to the data logger, record the general name of the program or setup before it is renamed), and the version number of the program or setup.
- RADIO. In addition, circle the type of radio (if a cellular modem, circle CDMA or GSM) and enter the information appropriate to that radio type, enter the antenna height above ground level in feet, circle the type of the antenna installed, the number of elements (if a yagi antenna is used), the true azimuth toward which the antenna is oriented, and the inclination relative to horizontal of the antenna if a GOES system.
    - LETS. Enter the frequency (or band of frequencies, in the case of a spread spectrum radio) at which the radio operates in MHz, the RF ID assigned to the station, and the ID of the station's RF subnet, if applicable.
    - CELL. Enter the service provider's name, the modem's electronic serial number (ESN or EIN), the mobile directory number (MDN), the mobile identification number (MIN or MSID; this is the modem's phone number), the IP address (if static; if dynamic, then enter "dynamic"), the network access ID, the system ID (SID), the network ID (NID), and the frequency band in MHz.
    - GOES. Enter the NESDIS ID, the baud rate, the channel indicated on the NESDIS assignment sheet in the "GOES NESDIS CHANNEL" box, the channel actually entered in the transmitter configuration (which is roughly half the value of the NESDIS channel for many transmitters for 1200 baud channels) in the "GOES TXER CHANNEL" box, the transmit time of the first transmission of the day in seconds past midnight UTC (the number shown on the NESDIS assignment sheet is given in minutes and seconds and must be converted to seconds), the transmit window in seconds, and the interval between transmissions in seconds.
- SOLRP and SOLRPS. In addition, enter the inclination of each solar panel (the direction the face of the panel is oriented) relative to horizontal.

6.6 Site Access

- Check the "Yes" box if National Weather Service and National Weather Service contractors will have unrestricted access to the site at all times, if "No", explain all restrictions in the text box.
- If there will be a locked gate or door controlling access to the station, circle "Y" in the "Locked Gate?" box, "N" otherwise. If the site host will allow NWS to daisy chain its own lock at the gate or door, circle "Y" in the "NWS Lock Allowed?" box, "N" otherwise. If an NWS lock has actually been installed at the gate or door, check "Y" in the "NWS Lock Installed?" box, "N" otherwise. If there is a non-NWS key lock, enter the number of keys acquired for NWS and NWS contractor use. If there is a gate or door with a key lock, NWS or not, enter the key number or ID. If there is a combination lock, enter the combination.

- Indicate whether the LETS agencies will require identification to enter any of their premises (e.g., local PD, state highway patrol office, etc.)
- Indicate whether 2-wheel-drive vehicles and 4-wheel-drive vehicles will be able to drive to the site throughout the year, and if not, explain why not and when access will or will not be possible in the text box for both 2WD and 4WD.
- Indicate whether the site host prefers not to have vehicles driven off-road under any conditions or has any restrictions on the route driven to the site, and explain all preferences and restrictions in detail.

6.7 Site Driving Directions

Describe how to drive to the site from a nearby intersection of two US/state highways or from an interstate highway exit. Include the distance driven to each turning or end point in tenths of a mile.

6.8 Site Host Special Instructions

Indicate how the site host prefers that maintainers dispose of grass cuttings from the site plot and describe any other special instructions that the site host has for anyone who might visit the station.

6.9 Site Contact Info

Enter as much of the contact information as possible, so that the site host can be contacted easily.

6.10 Notes

Take notes of any pertinent information that is not covered elsewhere in the form, which would have an effect on sensor exposure, station operation, or anyone visiting the site.

6.11 Obstructions

Use a rangefinder and compass to measure the range and direction to each obstruction within 330 feet (100 meters) of the center of the site plot. Draw each obstruction in its location relative to the station within the circle, using the azimuth lines and the circle edge (which indicates the 330-foot range from the center of the plot) as a guide. Label the true bearing from the center of the plot, the estimated or measured height in feet, and the distance to each obstruction. In the case of large obstructions or closely-spaced groups of obstructions, such as trees, draw the approximate shape of the areal coverage of the group, as viewed from above, and label the ranges of bearing, height, and distance.

7 Submission of Documentation

All forms and photos documenting maintenance and problem fix visits should be submitted to the ISOS Office within 5 business days after completing the maintenance or fix. Electronic versions of all required forms, which include provision for entering all required information electronically, will be supplied to the maintenance contractors. When scanning a form for submission because it is not possible to submit an electronic copy (e.g., the metadata form obstruction drawing), it should be scanned at 300 dpi in grayscale mode and submitted in JPEG format. All documentation should be submitted to the ISOS Office in electronic form by FTP to the following address:

IP Address: 129.15.195.100
User Name: batman
Password: bobkane

Forms should be uploaded to the directory corresponding to the state in which the station is located within the "Maintenance Forms" directory. Photos should be uploaded to the directory corresponding to the state in which the station is located within the "Maintenance Pictures" directory.

Whenever documentation is submitted to the FTP site, send an email notification to Gavin Essenberg at Gavin.Essenberg@noaa.gov so that the metadata database can be updated as soon as possible.

Use the following naming convention for all forms submitted to the FTP site:

STIDYYYYMMDDFT.xxx

where

STID = the 3- or 5-character station ID
YYYY = year maintenance or fix completed
MM = month maintenance or fix completed
DD = day of the month maintenance or fix completed
FT = form type (see Table 9 below)
xxx = document extension (e.g., doc, pdf, jpg)

Table 9. Entries to use for the form type portion of an electronic form name.

Form	FT
Remote Station Maintenance Form for Technicians	RM
Repeater and Base Station Maintenance Form for Technicians	RBM
Remote Weather Station Maintenance Form for Site Hosts, Observers, and NWS WFOs	RMNT
Trouble Ticket/Site Visit Form documenting problem report or fix, where # is the trouble ticket number	TT#
Trouble Ticket/Site Visit Form documenting site visit only	SV
Trouble Ticket Form for Mass Installs, Fixes, or Moves	MI
GEONOR Precipitation Gauge Calibration Form	GC
Metadata Form	MD

Example:
The following example indicates the proper naming of documentation for a fictional visit to North Foster, RI (FTFR1) on June 6, 2005:

FTFR120050606RM.doc – remote station maintenance form completed by a technician
FTFR120050606RMNT.doc – remote station maintenanc form completed by a site host, observer, or WFO
FTFR120050606TT46.doc – trouble ticket number 46
FTFR120050606SV.doc – Trouble Ticket/Site Visit Form used to report a Site Visit only (not a problem or a fix)
FTFR120050606MI.doc – mass install trouble ticket form
FTFR120050606GC.doc – GEONOR calibration sheet
FTFR120050606MD.doc – metadata form

Appendix A Precipitation Gauge Antifreeze Guide

This appendix explains the procedures for winterizing the GEONOR precipitation gauge. Table 11 below, which is based on CRN's "USCRN Site Anti-Freeze Table" lists the amount of antifreeze to use, the date to add the antifreeze in the fall, the date to remove the antifreeze in the spring, and estimates of the number of times a gauge will have to emptied, the amount of antifreeze and oil needed, and the amount of water/antifreeze waste generated per winter for a single gauge for each climate division in the New England states. The table will soon be updated to include all of the climate divisions in the contiguous United States.

Table 11 is organized by state and then climate division within each state. The following bullet points describe the meaning and use of each column.

- "Add Mixture Date" is the date in the fall when antifreeze should be added and corresponds to the date with a 10 percent probability of the temperature falling to 28° F or less at an earlier date.
- "Remove Mixture Date" is the date in the spring when antifreeze should be removed and corresponds to the date with a 10 percent probability of the temperature falling to 28° F or less at a later date.
- "Amount to Add" is the amount of the antifreeze mixture, in liters or quarts, to add during the winter period between the add and remove dates. The amounts are determined based on the record minimum temperature for each climate division, following GEONOR's recommendations, reproduced in Table 10 below:

Table 10. GEONOR antifreeze amount recommendations based on record minimum temperature.

Temperature		Amount of Antifreeze (L)	Amount of Antifreeze (Qt)	Temperature		Amount of Antifreeze (L)	Amount of Antifreeze (Qt)
23° F	-5° C	1.5	1.6	-13° F	-25° C	5.0	5.3
14° F	-10° C	2.6	2.7	-22° F	-30° C	5.6	5.9
5° F	-15° C	3.6	3.8	-31° F	-35° C	6.0	6.3
-4° F	-20° C	4.2	4.4				

NOTE: The antifreeze to be used is propylene glycol.

- "Normal Winter Precip" is the normal liquid equivalent precipitation for the climate region from the add date to the remove date, in inches.
- "Vol Equiv." is the volume equivalent of the normal winter precipitation for the GEONOR precipitation gauge in quarts. This is the number of quarts of liquid that will be collected in the gauge if the normal winter precipitation falls. This is used as a guide in estimating the number of times that the gauge must be emptied between the add and remove dates.
- "Number of Fills" is the number of times that the bucket must be filled with antifreeze from the add date to the remove date and corresponds to the number of times that the gauge must be emptied, as well. This number was calculated by multiplying the normal winter precipitation by 1.5 to allow for abnormalities, dividing by the amount of precipitation in one

collection period, and rounding up to the next whole number. The bucket is assumed to be emptied when 75% full (9 liters/9.5 quarts), so the amount of precipitation in one collection period is 9.5 quarts minus the amount of antifreeze added.

- "Yearly Req. (Qts)" is the total estimated amount of antifreeze required per winter in quarts. It is equal to the amount of antifreeze required multiplied by the number of times filled.
- "Yearly Req. (Gal)" is the total estimated amount of antifreeze required per winter in gallons.
- "Total Waste" is the total estimated amount of waste mixture removed from the gauge per winter in gallons. It is equal to the normal winter precipitation multiplied by 1.5 plus the estimated yearly amount of antifreeze required.

The figures on the pages following Table 11 are maps showing the locations of the climate divisions and their relation with county boundaries. The maps will allow the determination of the climate division in which each National Cooperative Mesonet station is located.

Table 11. Precipitation gauge antifreeze table.

State	Climate Division Number	Climate Division Name	Add Mixture Date	Remove Mixture Date	Amount to Add (L)	Amount to Add (Qt.)	Normal Winter Precip (in.)	Vol Equiv. (Qt.)	Number of Fills	Yearly Req. (Qt.)	Yearly Req. (Gal)	Total Waste (Gal)
CT	1	Northwest	15-Sep	15-May	6.0	6.3	32.36	17.4	8	52.1	13.0	19.5
CT	2	Central	1-Oct	15-May	6.0	6.3	31.76	17.0	8	51.1	12.8	19.2
CT	3	Coastal	1-Oct	15-May	5.6	5.9	30.40	16.3	7	40.3	10.1	16.2
ME	1	Northern	1-Sep	15-Jun	6.0	6.3	29.73	16.0	8	47.9	12.0	18.0
ME	2	Southern Interior	15-Sep	1-Jun	6.0	6.3	31.52	16.9	8	50.8	12.7	19.0
ME	3	Coastal	15-Sep	1-Jun	6.0	6.3	36.51	19.6	9	58.8	14.7	22.0
MA	1	Western	15-Sep	1-Jun	6.0	6.3	34.82	18.7	9	56.1	14.0	21.0
MA	2	Central	15-Sep	1-Jun	6.0	6.3	33.79	18.1	9	54.4	13.6	20.4
MA	3	Coastal	1-Oct	15-May	5.6	5.9	30.88	16.6	7	41.0	10.2	16.5
NH	1	Northern	1-Sep	15-Jun	6.0	6.3	31.66	17.0	8	51.0	12.7	19.1
NH	2	Southern	15-Sep	1-Jun	6.0	6.3	30.81	16.5	8	49.6	12.4	18.6
NY	1	Western Plateau	1-Sep	15-Jun	6.0	6.3	29.84	16.0	8	48.1	12.0	18.0
NY	2	Eastern Plateau	15-Sep	1-Jun	6.0	6.3	29.93	16.1	8	48.2	12.0	18.1
NY	3	Northern Plateau	1-Sep	15-Jun	6.0	6.3	35.37	19.0	9	57.0	14.2	21.4
NY	4	Coastal	1-Oct	1-May	5.6	5.9	27.60	14.8	6	36.6	9.2	14.7
NY	5	Hudson Valley	15-Sep	1-Jun	6.0	6.3	30.26	16.2	8	48.7	12.2	18.3
NY	6	Mohawk Valley	15-Sep	1-Jun	6.0	6.3	31.05	16.7	8	50.0	12.5	18.8
NY	7	Champlain Valley	1-Sep	15-Jun	6.0	6.3	26.72	14.3	7	43.0	10.8	16.1
NY	8	St. Lawrence Valley	15-Sep	1-Jun	6.0	6.3	24.37	13.1	6	39.2	9.8	14.7
NY	9	Great Lakes	1-Oct	1-Jun	6.0	6.3	24.87	13.4	6	40.1	10.0	15.0
NY	10	Central Lakes	15-Sep	1-Jun	6.0	6.3	23.60	12.7	6	38.0	9.5	14.3
RI	1	Rhode Island	15-Sep	15-May	5.6	5.9	33.51	18.0	8	44.4	11.1	17.9
VT	1	Northeastern	1-Sep	1-Jun	6.0	6.3	30.97	16.6	8	49.9	12.5	18.7
VT	2	Western	1-Sep	1-Jun	6.0	6.3	26.95	14.5	7	43.4	10.9	16.3
VT	3	Southeastern	1-Sep	1-Jun	6.0	6.3	34.30	18.4	9	55.2	13.8	20.7

Figure 15. Climate division and state boundaries for the contiguous United States.

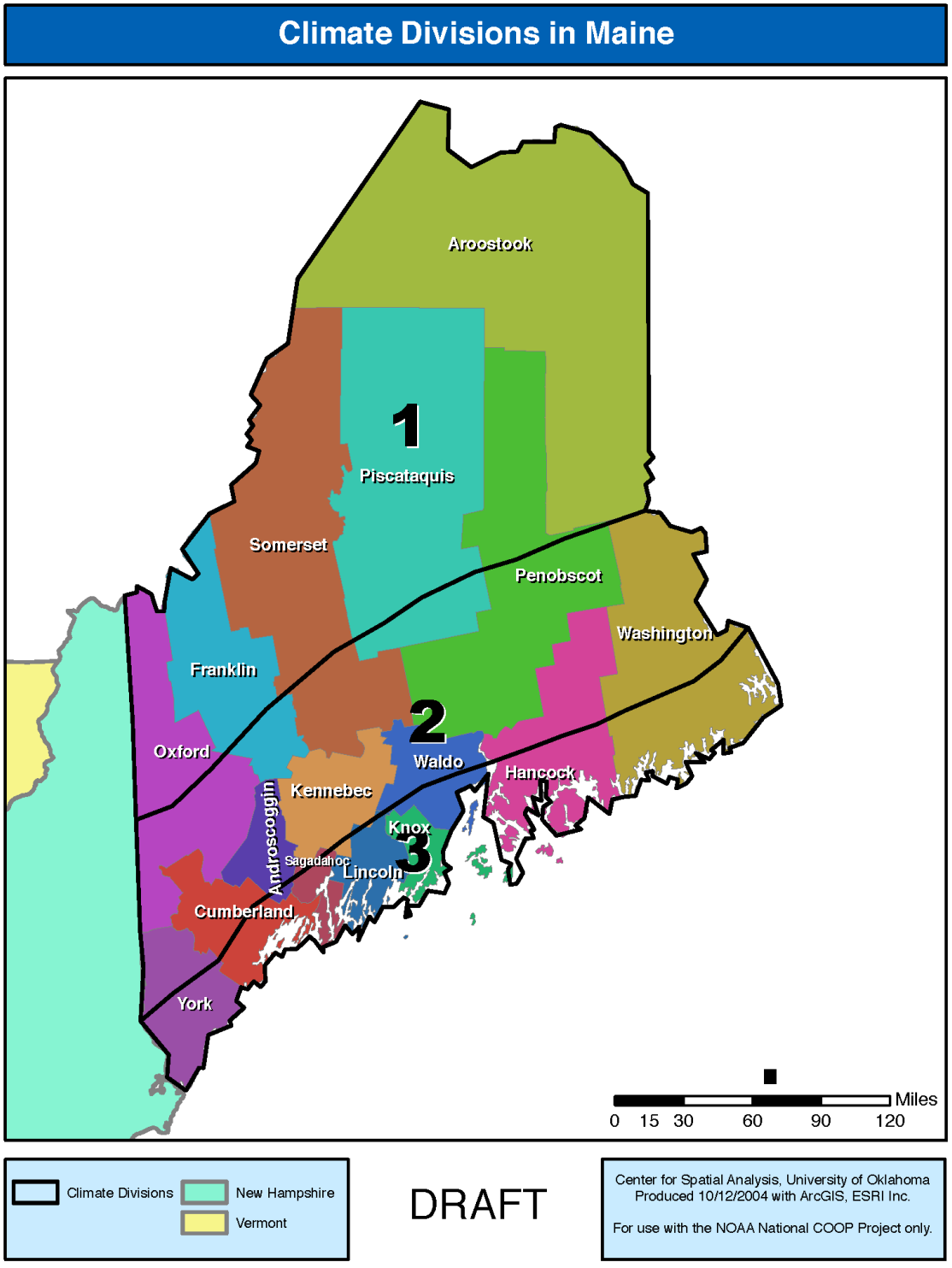


Figure 16. Climate division and county boundaries in Maine.

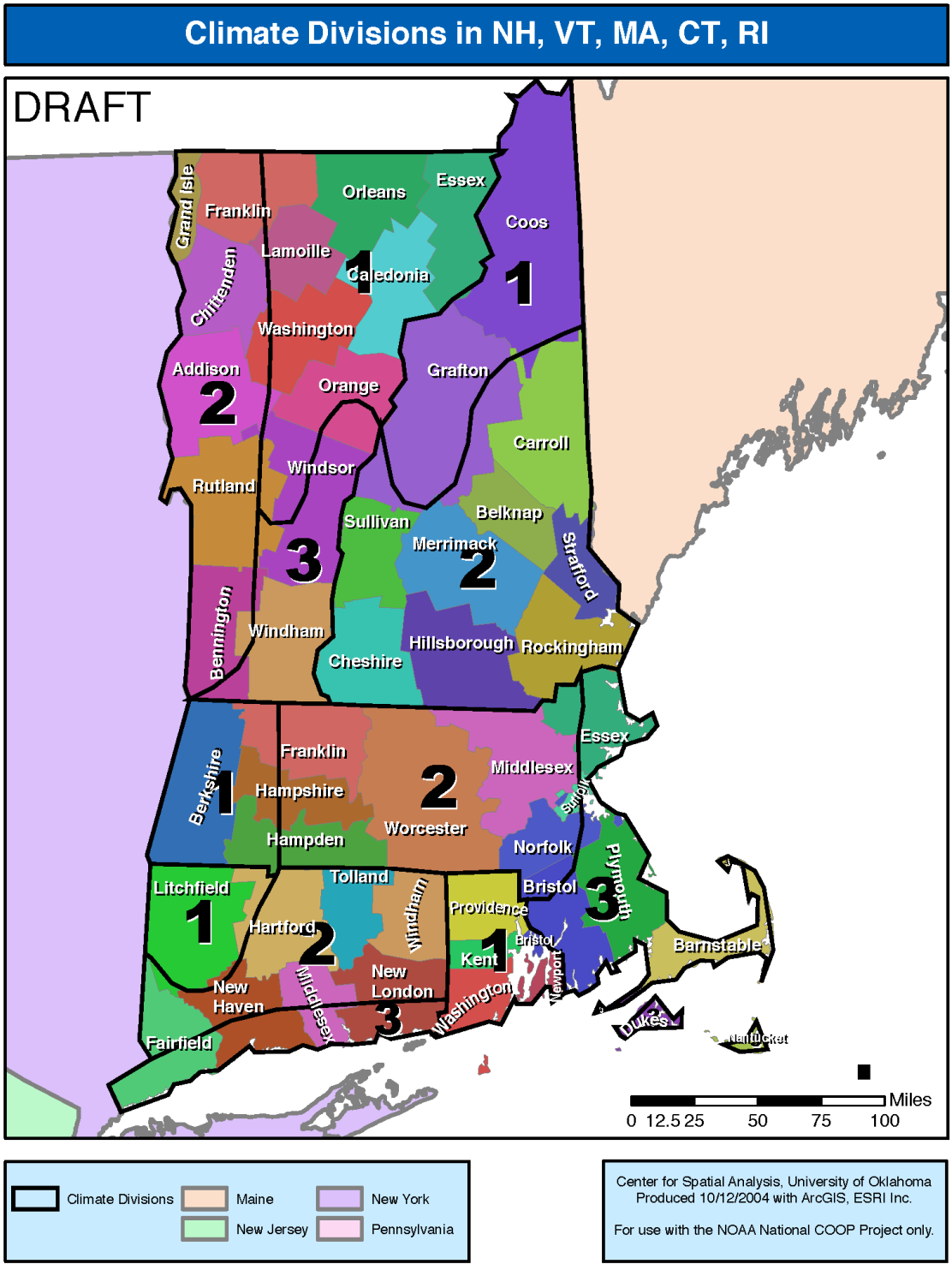


Figure 17. Climate division and county boundaries in Vermont, New Hampshire, Masschussetts, Connecticut, and Rhode Island.

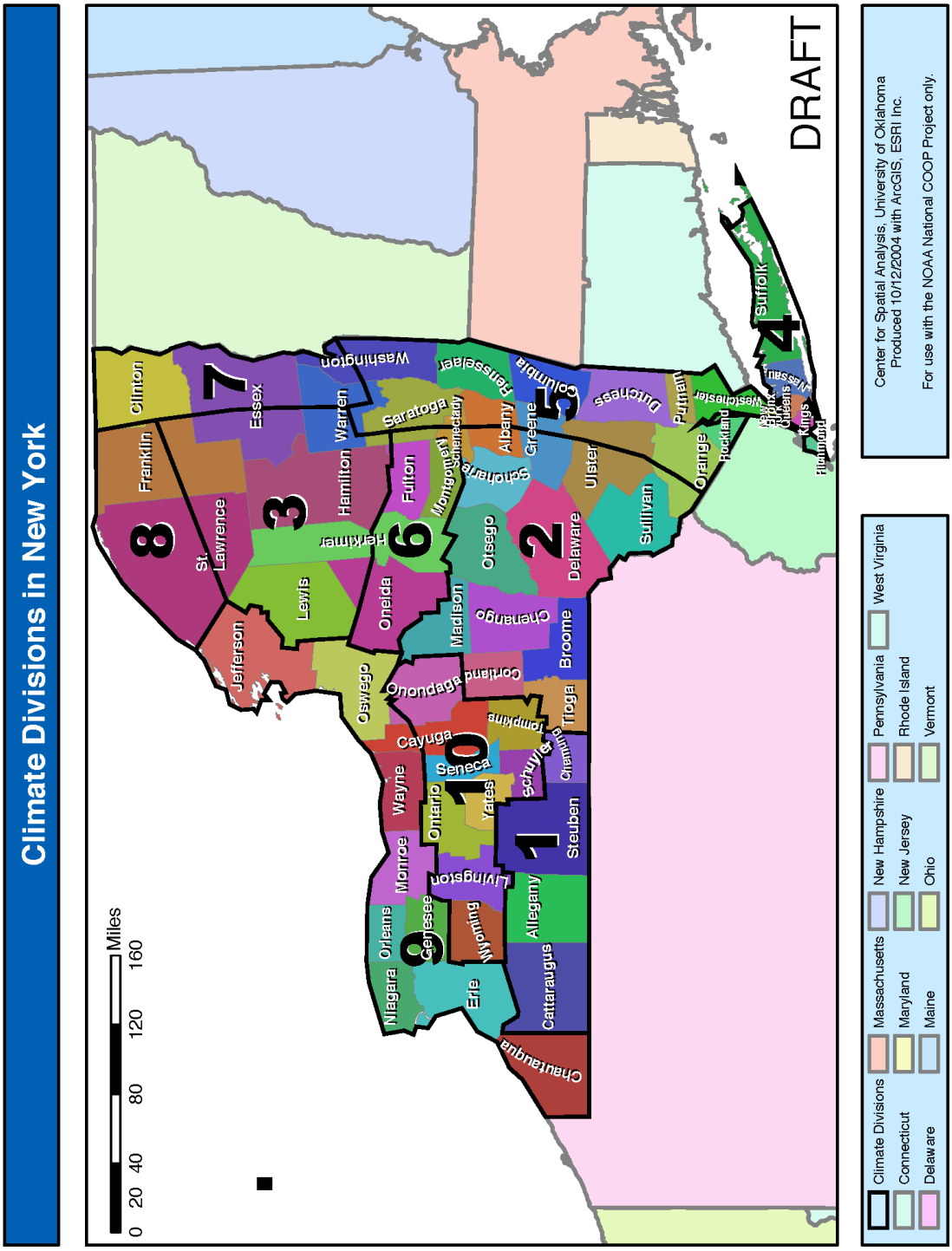
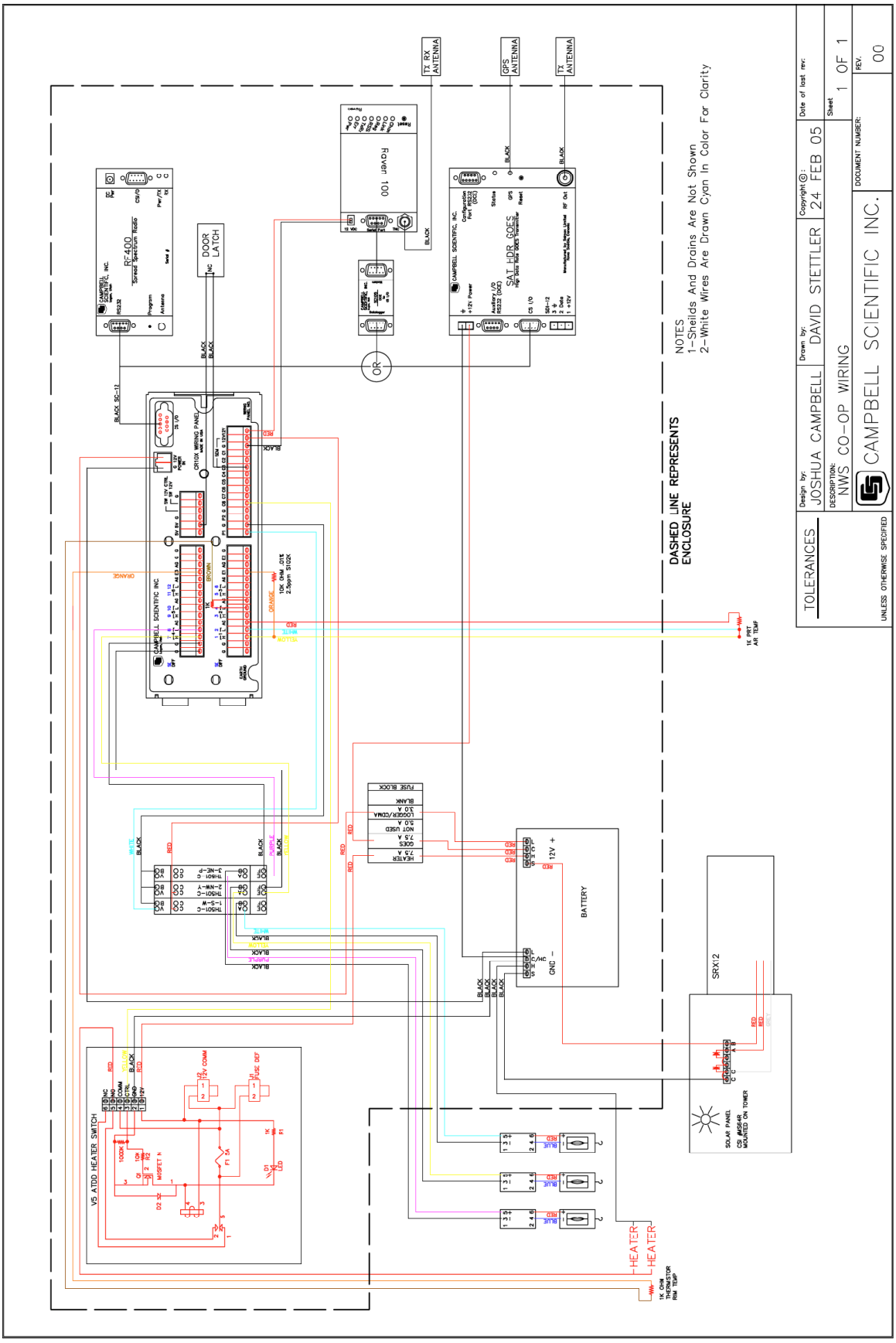
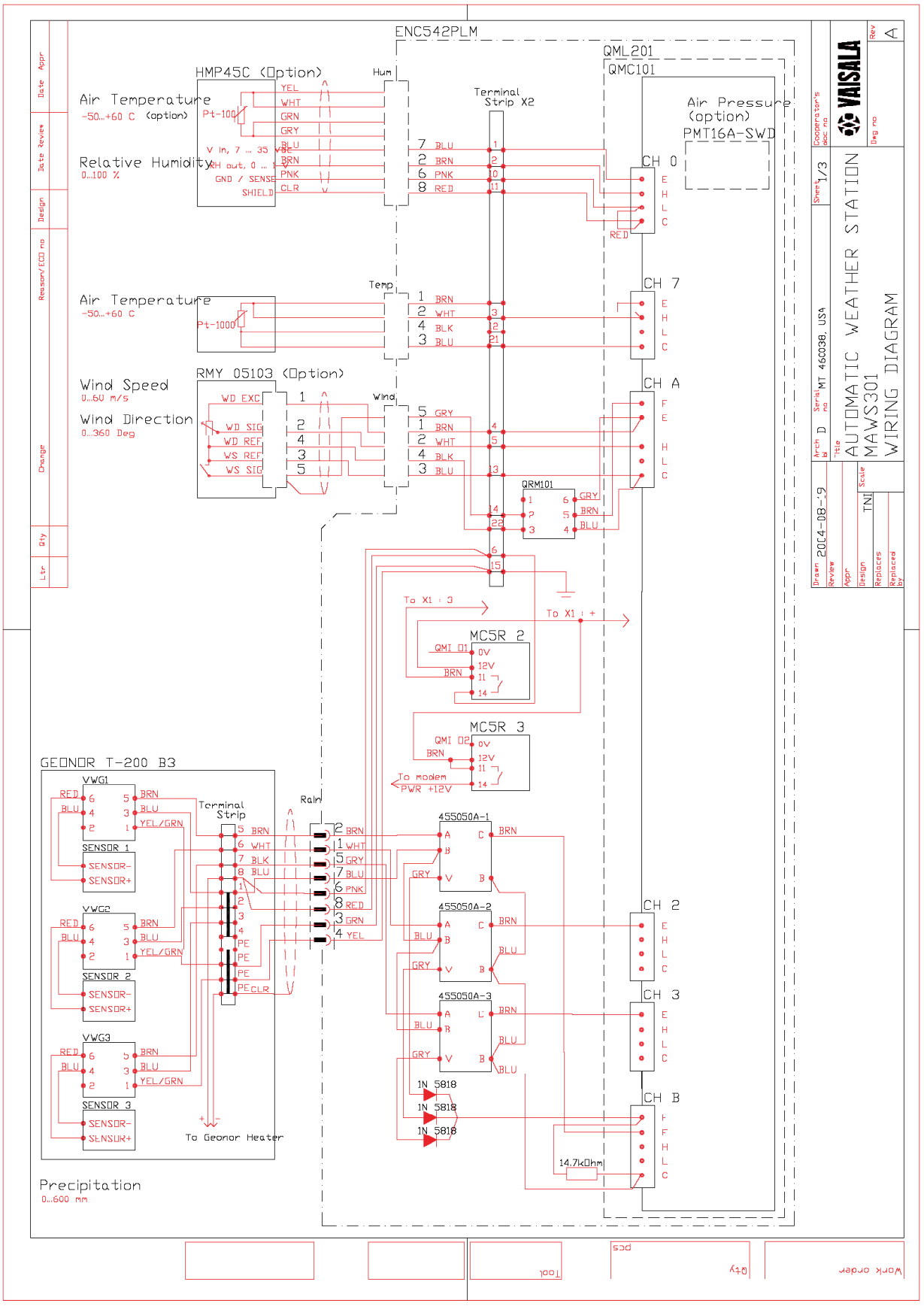


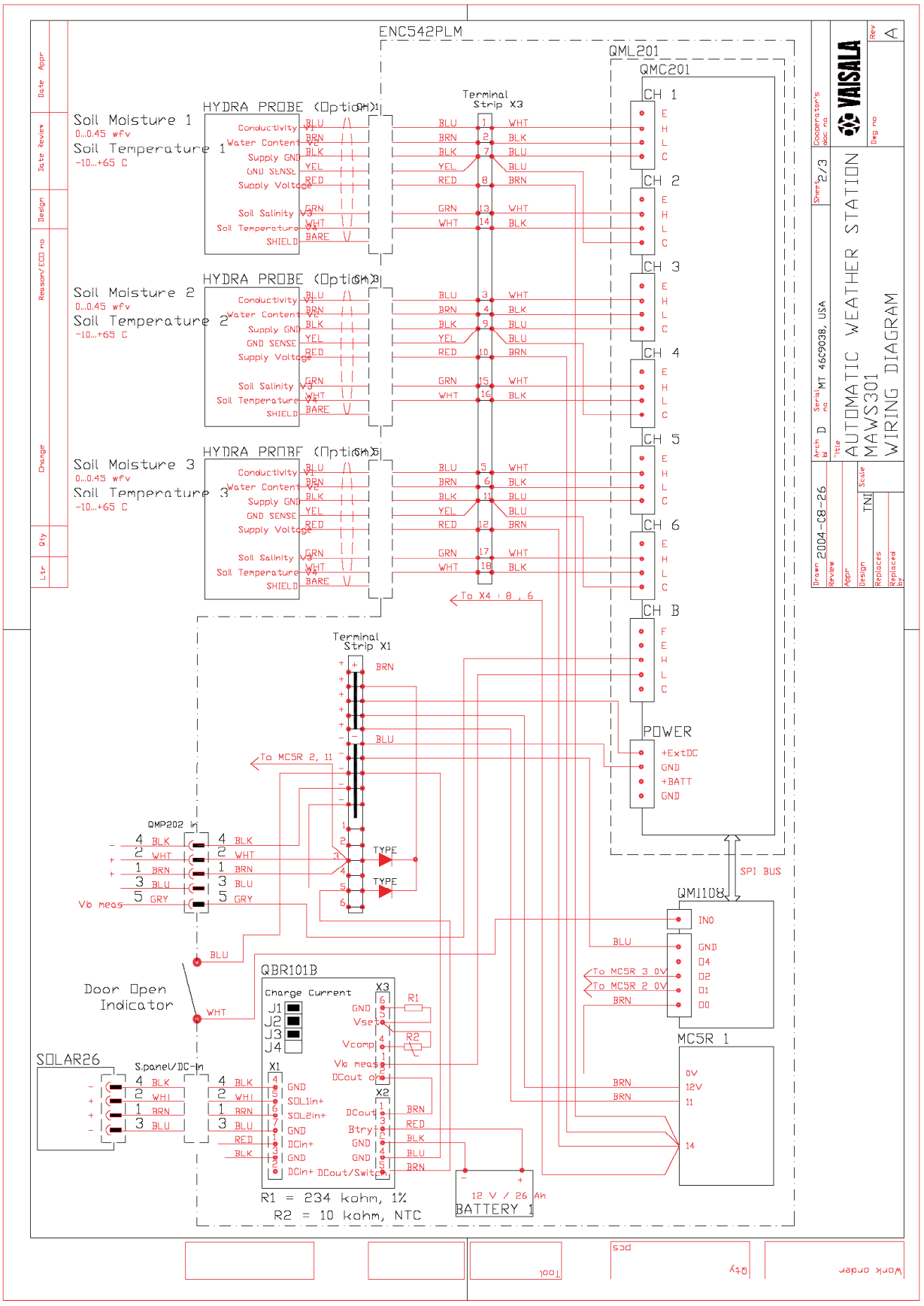
Figure 18. Climate division and county boundaries in New York.

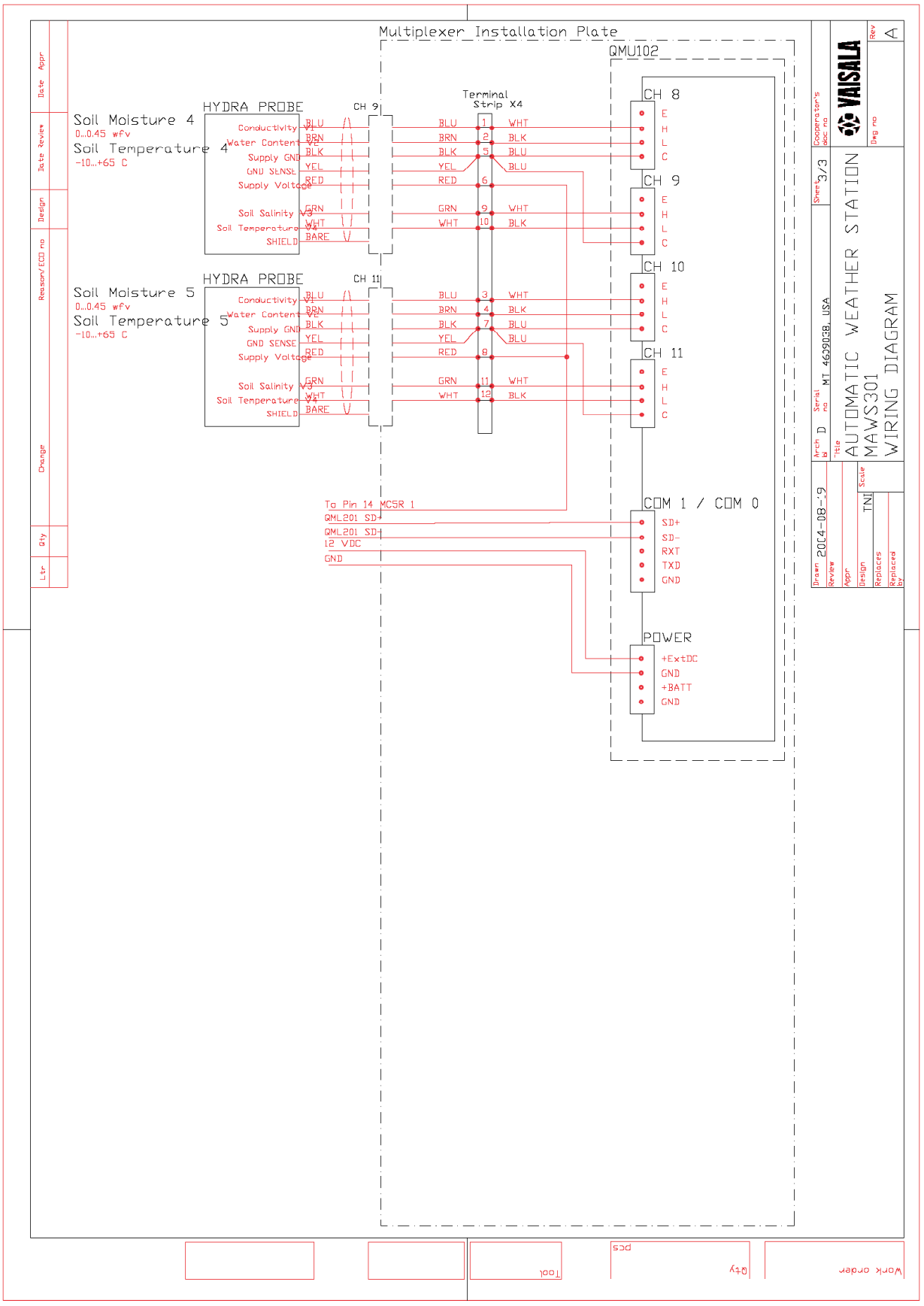
Appendix B Remote Station Wiring Diagrams

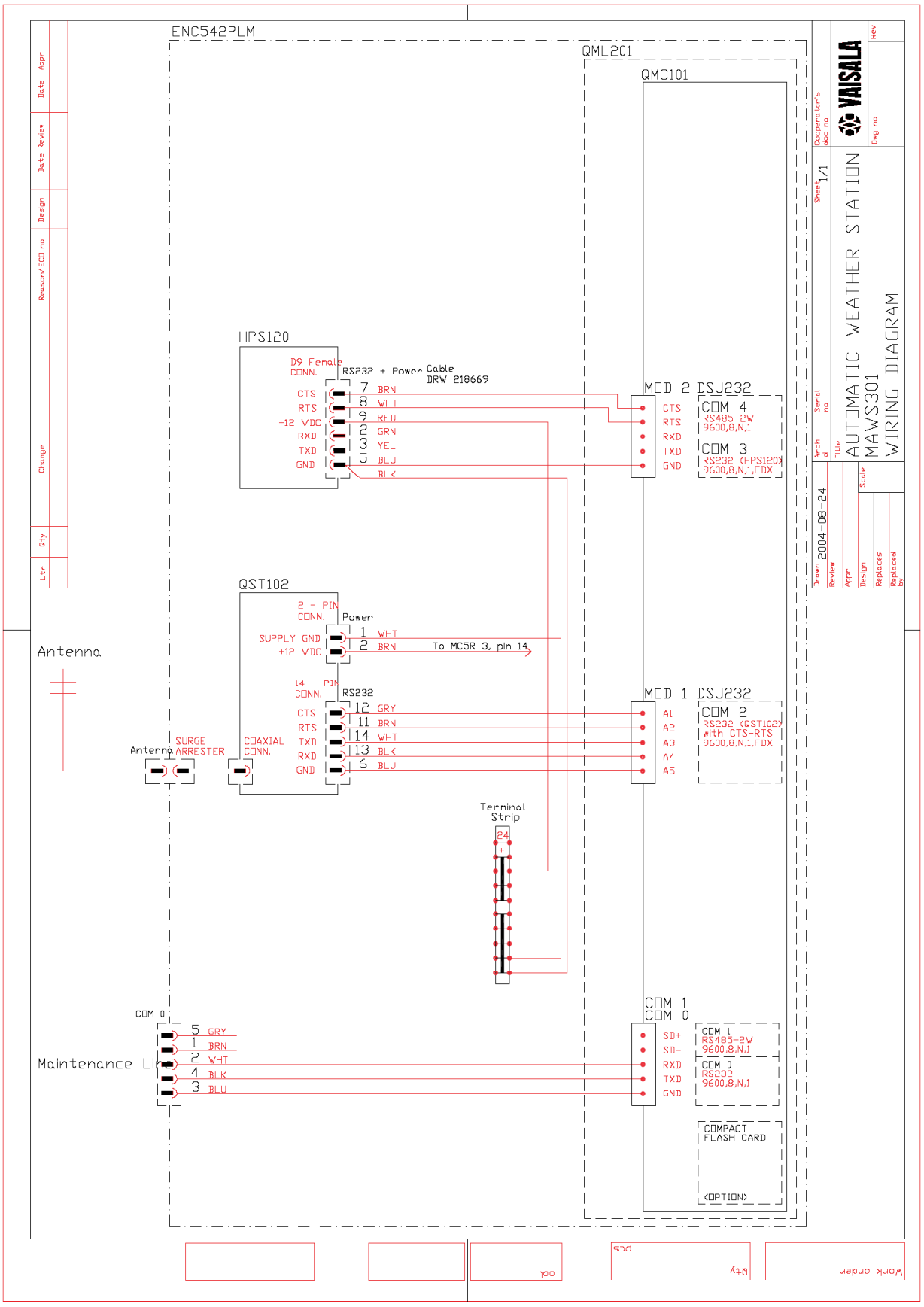
The schematic diagrams on the following pages indicate the wiring connections between components at both Campbell-logger-based and Vaisala-logger-based NERON remote weather stations.

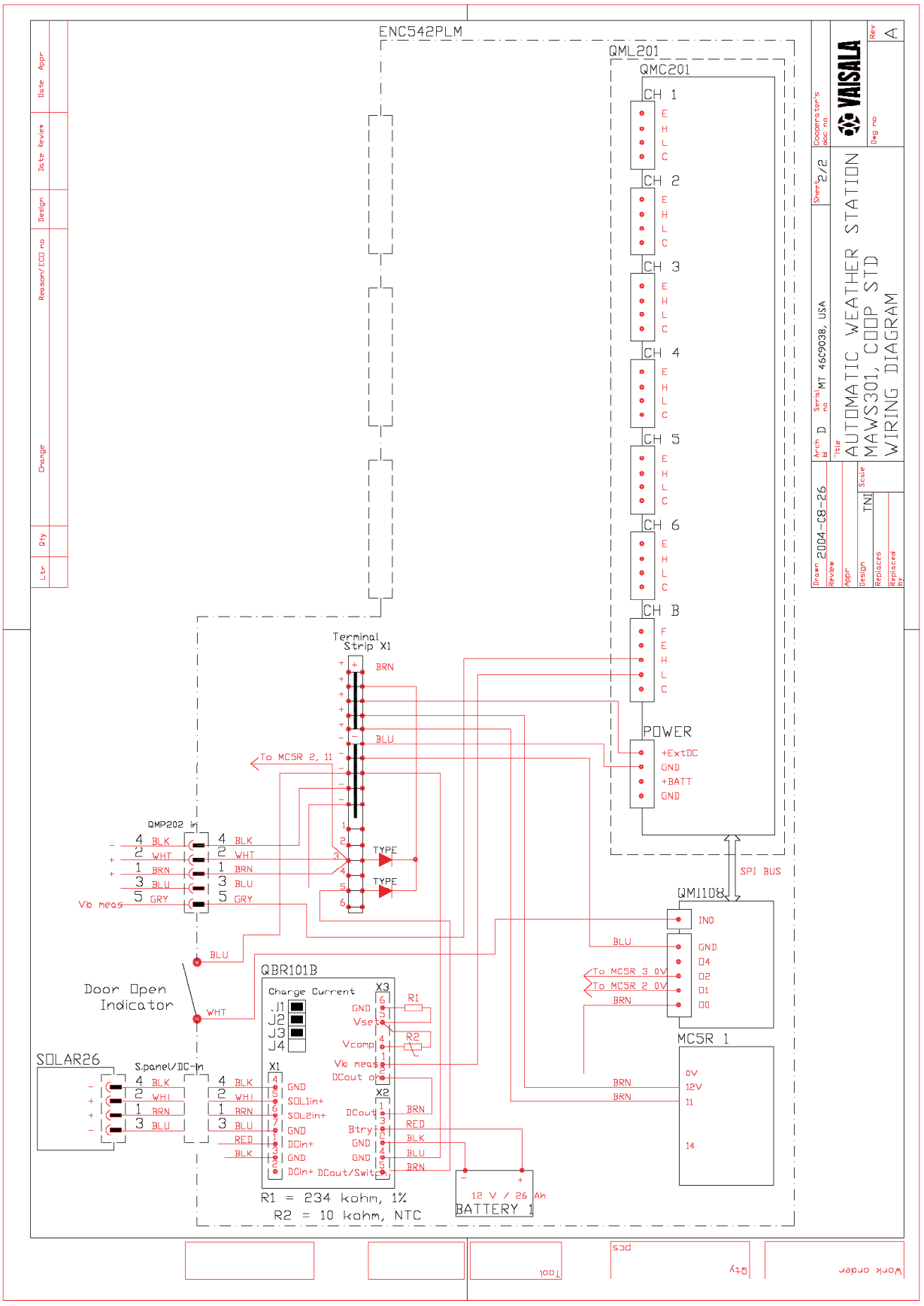

TX RX ANTENNA
GPS ANTENNA
TX ANTENNA
RF400
Spread Spectrum Radio
DOOR LATCH
Power 100
SAT HDR GOES
High Data Rate GOES Transmitter
OR
CR10X WIRING PANEL
CAMPBELL SCIENTIFIC INC
DASHED LINE REPRESENTS ENCLOSURE
NOTES
1-Sheilds And Drains Are Not Shown
2-White Wires Are Drawn Cyan In Color For Clarity
1K PRT AIR TEMP
1K OHM THERMISTOR RAM TEMP
HEATER
HEATER
BATTERY
SRX12
SOLAR PANEL
CS_MSR4R MOUNTED ON TOWER
V5 ATDD HEATER SWITCH
PULSE BLOCK
HEATER 7.5 A
GOES 7.5 A
NOT USED 5.0 A
LOGGER/CDMA 5.0 A
BLANK
TOLERANCES
UNLESS OTHERWISE SPECIFIED
Design by: JOSHUA CAMPBELL
Drawn by: DAVID STETTLER
Copyright ©: 24 FEB 05
Date of last rev:
DESCRIPTION: NWS CO-OP WIRING
CAMPBELL SCIENTIFIC INC.
DOCUMENT NUMBER:
Sheet 1 OF 1
REV. 00


ENC542PLM
QML201
QMC101
HMP45C (option)
Air Temperature
-50...+60 C (option)
Relative Humidity
0...100 %
Hum
Terminal Strip X2
Air Pressure (option)
PMT16A-SWD
CH 0
CH 7
CH A
CH 2
CH 3
CH B
Air Temperature
-50...+60 C
Temp
RMY 05103 (option)
Wind Speed
0...60 m/s
Wind Direction
0...360 Deg
Wind
QRM101
To X1 : 3
To X1 : +
MC5R 2
MC5R 3
To modem
PWR +12V
GEONOR T-200 B3
VWG1
VWG2
VWG3
SENSOR 1
SENSOR 2
SENSOR 3
Terminal Strip
Rain
455050A-1
455050A-2
455050A-3
1N 5818
14.7kOhm
To Geonor Heater
Precipitation
0...600 mm
VAISALA
AUTOMATIC WEATHER STATION
MAWS301
WIRING DIAGRAM
Sheet 1/3
Drawn 2004-08-19
Scale TN
Rev A


ENC542PLM
QML201
QMC201
Terminal Strip X3
HYDRA PROBE (Option)
Soil Moisture 1
0...0.45 wfv
Soil Temperature 1
-10...+65 C
Soil Moisture 2
0...0.45 wfv
Soil Temperature 2
-10...+65 C
Soil Moisture 3
0...0.45 wfv
Soil Temperature 3
-10...+65 C
Conductivity
Water Content
Supply GND
GND SENSE
Supply Voltage
Soil Salinity
Soil Temperature
SHIELD
CH 1
CH 2
CH 3
CH 4
CH 5
CH 6
CH B
To X4 : 8 , 6
Terminal Strip X1
To MC5R 2, 11
QMP202 in
TYPE
Vb meas
Door Open Indicator
QBR101B
Charge Current
SOLAR26
S.panel/DC-in
POWER
+ExtDC
GND
+BATT
SPI BUS
QMI108
To MC5R 3 0V
To MC5R 2 0V
MC5R 1
0V
12V
11
14
R1 = 234 kohm, 1%
R2 = 10 kohm, NTC
12 V / 26 Ah
BATTERY 1
VAISALA
AUTOMATIC WEATHER STATION
MAWS301
WIRING DIAGRAM
Drawn 2004-08-26
Arch D
Title
Sheet 2/3
Rev A
Scale TNI


Multiplexer Installation Plate
QMU102
Terminal Strip X4
HYDRA PROBE
Soil Moisture 4
0...0.45 wfv
Soil Temperature 4
-10...+65 C
CH 9
Conductivity V1
Water Content V2
Supply GND
GND SENSE
Supply Voltage
Soil Salinity V3
Soil Temperature V4
SHIELD
BLU
BRN
BLK
YEL
RED
GRN
WHT
BARE
HYDRA PROBE
Soil Moisture 5
0...0.45 wfv
Soil Temperature 5
-10...+65 C
CH 11
CH 8
CH 9
CH 10
CH 11
E
H
L
C
To Pin 14 MCSR 1
QML201 SD+
QML201 SD-
12 VDC
GND
COM 1 / COM 0
SD+
SD-
RXT
TXD
GND
POWER
+ExtDC
GND
+BATT
GND
VAISALA
AUTOMATIC WEATHER STATION
MAWS301
WIRING DIAGRAM
Rev A
Sheet 3/3
Arch D
Title
Serial no M1 4629038 USA
Drawn 2014-08-19
Review
Appr
Design
Scale TNI
Replaces
Replaced by
Date Appr
Date Review
Design
Reason/ECO no
Change
Qty
Ltr
Cooperator's doc no
Dwg no
Work order
Qty
pcs
Tool


ENC542PLM
QML201
QMC101
VAISALA
AUTOMATIC WEATHER STATION
MAWS301
WIRING DIAGRAM
Sheet 1/1
Drawn 2004-08-24
Review
Appr
Design
Replaces
Replaced by
Scale
Title
Arch
Serial no
Cooperation's doc no
Dwg no
Rev
Date Appr
Date Review
Design
Reason/ECO no
Change
Qty
Ltr
HPS120
D9 Female CONN.
RS232 + Power Cable DRW 218669
CTS 7 BRN
RTS 8 WHT
+12 VDC 9 RED
RXD 2 GRN
TXD 3 YEL
GND 5 BLU
BLK
MOD 2 DSU232
CTS
RTS
RXD
TXD
GND
COM 4
RS485-2W
9600,8,N,1
COM 3
RS232 (HPS120)
9600,8,N,1,FDX
QST102
2 - PIN CONN.
Power
SUPPLY GND 1 WHT
+12 VDC 2 BRN
To MC5R 3, pin 14
14 PIN CONN.
RS232
CTS 12 GRY
RTS 11 BRN
TXD 14 WHT
RXD 13 BLK
GND 6 BLU
Antenna
SURGE ARRESTER
Antenna
COAXIAL CONN.
MOD 1 DSU232
A1
A2
A3
A4
A5
COM 2
RS232 (QST102)
with CTS-RTS
9600,8,N,1,FDX
Terminal Strip
24
+
-
COM 0
5 GRY
1 BRN
2 WHT
4 BLK
3 BLU
Maintenance Link
COM 1
COM 0
SD+
SD-
RXD
TXD
GND
COM 1
RS485-2W
9600,8,N,1
COM 0
RS232
9600,8,N,1
COMPACT FLASH CARD
(OPTION)
Work order
Qty
pcs
Tool


ENC542PLM
QML201
QMC201
CH 1
CH 2
CH 3
CH 4
CH 5
CH 6
CH B
POWER
+ExtDC
GND
+BATT
GND
SPI BUS
QMI108
IN0
GND
MC5R 1
0V
12V
11
14
Terminal Strip X1
BRN
BLU
To MC5R 2, 11
TYPE
TYPE
QMP202 in
BLK
WHT
BRN
BLU
GRY
Vb meas
BLU
Door Open Indicator
WHT
QBR101B
Charge Current
J1
J2
J3
J4
X3
X1
X2
R1
R2
GND
Vset
Vcomp
Vb meas
DCout ok
DCout
Btry
SDL1in+
SDL2in+
DCin+
DCout/Switch
RED
To MC5R 3 0V
To MC5R 2 0V
SOLAR26
S.panel/DC-in
R1 = 234 kohm, 1%
R2 = 10 kohm, NTC
12 V / 26 Ah
BATTERY 1
VAISALA
AUTOMATIC WEATHER STATION
MAWS301, COOP STD
WIRING DIAGRAM
Sheet 2/2
Arch D
Title
Serial no MT 4669038, USA
Drawn 2004-08-26
Review
Appr
Design
Replaces
Replaced by
Scale TNI
Rev A
Dwg no
Cooperator's doc no
Date Appr
Date Review
Design
Reason/ECO no
Change
Qty
Ltr
Work order
Qty
Tool

Appendix C Forms

This appendix contains all of the following forms necessary for site maintenance, listed in the order included:

1. NERON Remote Station Maintenance Form for Technicians
2. NERON Repeater and Base Station Maintenance Form for Technicians
3. NERON Remote Weather Station Maintenance Form for Site Hosts, Observers, and NWS WFOs

4. NERON Trouble Ticket/Site Visit Form
5. NERON Trouble Ticket Form for Mass Installs, Fixes, or Moves

6. GEONOR Precipitation Gauge Calibration Sheet

7. NERON Station Metadata Form

Form Date: March 10, 2005

NERON REMOTE STATION MAINTENANCE FORM FOR TECHNICIANS

NOTE: An electronic copy of this form must be submitted to the ISOS Office to be counted against the required visit quota.

STATION ID	UTC DATE ARRIVE	UTC TIME ARRIVE	UTC DATE DEPART	UTC TIME DEPART	MAINT. CONTRACTOR	TECHNICIAN(S)

1. ☐ Logger enclosure opened to set door open flag and station arrival time from datalogger recorded at top of form

2. Arrival Photos (Blank spaces are to record photo numbers, if desired)

☐ Soil moisture plots: **SMEA _____ SMWA _____** ☐ Skin temperature footprint: **STFPA _____**

☐ Inside vegetation height from NW showing veg height gauge 4 ft E of mast/tower: **IHA _____**

☐ Outside vegetation height from S showing veg height gauge 10 ft S of south plot edge: **OH _____**

3. Visual Inspection (Enter Y for yes **or O for** no **in each box. Indicate any abnormalities or obstructions removed in the notes section on the back)**

EQUIP.	INSPECTED?	ABNORMALITY?	EQUIP.	INSPECTED?	ABNORMALITY?	EQUIP.	INSPECTED?	ABNORMALITY?
Mast/Tower			Sensors			Terrain		
Enclosures			PRECIP			Vegetation		
Radn Shields			Cables					

4. Vegetation Maintenance

☐ Vegetation cut to between 1- and 3-inch height

5. Tall Tower Maintenance

☐ Tower plumb ☐ Guy wire tension checked/adjusted ☐ Safety inspection complete (once per year)

6. General Maintenance (Enter Y for yes**, O for** no**, or — for** not applicable **in each box)**

CLEANING	CLEAN ON ARRIVAL	CLEANED
TAIR Shelter		
RELH Shelter		
Solar Panel(s)		
Battery Terminals		
Volt Reg Terminals		

CLEANING/ LEVELING	CLEAN ON ARRIVAL	CLEANED	LEVEL ON ARRIVAL	LEVELED
PRECIP				
SRAD				
IRTT				

WIND SPEED	NOISY BEARINGS	CUPS CLEANED
WSPD		
WS2M		

☐ Desiccant replaced (16 units every 6 months in logger enclosures w/o cable glands or one-way air valves)

☐ Wire terminal connections tightened (spring only)

☐ Verified door switch operation

☐ Replaced all batteries that failed load test (fall only)

7. Precipitation Gauge Maintenance (Calibration verification required only once per year)

☐ Emptied bucket

☐ Added antifreeze (winter season) ⟶

AMOUNG OF ANTIFREEZE ADDED (L)

☐ Removed antifreeze (start of warm season)

☐ Added 0.5 L (0.5 qt) oil

☐ Calibrated gauge (submit completed calibration sheet)

☐ Verified GEONOR wiring secure and not in contact with bucket or bucket pan

☐ Verified rim heater operation, if installed and operational (fall only)

CAL VERIF	PRECIP S/N: SER. NO.	Curr. In.	Prev. in.	% Diff.
VWPCP1				
VWPCP2				
VWPCP3				
Avg.				

8. Sensor Rotation (Check all that apply and include completed trouble ticket form)

☐ LOGG ☐ TAIR ☐ WSPD ☐ WDIR ☐ WS2M ☐ PRES ☐ SRAD ☐ IRTT ☐ RELH ☐ DEWPNT

9. Communication System Maintenance

RF POWER	FWD	REF
Arrival		
Departure		

☐ Inspected antenna cable for damage

☐ Inspected antenna cable connectors for corrosion

☐ Inspected antenna for damage

☐ Inspected antenna connector for corrosion

10. Departure Photos

☐ Soil moisture plots: **SMED _____ SMWD _____** ☐ Skin temperature footprint: **STFPD _____**

☐ Inside vegetation height from NW showing veg height gauge 4 ft E of mast/tower: **IHD _____**

11. ☐ Checked ALL datalogger input locations for normal readings

☐ Verified that station transmitting and, if not GOES site, receiving

☐ All holes in logger enclosure and conduit openings duct sealed

☐ Station departure time from datalogger recorded at top of form, and, if Campbell logger, placed in *0 mode

☐ All enclosures locked

12. Documentation Submitted to ISOS Office

☐ This two-sided maintenance form ☐ Photos ☐ Trouble ticket(s), if applicable

CONTRACTOR REPRESENTATIVE NAME	DATE SUBMITTED TO NWS	DATE RECEIVED BY NWS

NERON REMOTE STATION MAINTENANCE FORM FOR TECHNICIANS (BACK)

NOTES:

Form Date: March 10, 2005

NERON REPEATER AND BASE STATION MAINTENANCE FORM FOR TECHNICIANS

NOTE: An electronic copy of this form must be submitted to the ISOS Office to be counted against the required visit quota.

STATION ID	UTC DATE ARRIVE	UTC TIME ARRIVE	UTC DATE DEPART	UTC TIME DEPART	MAINT. CONTRACTOR	TECHNICIAN(S)

1. Visual Inspection (Enter Y for yes **or O for** no **in each box. Indicate any abnormalities or obstructions removed in the notes section on the back)**

EQUIP.	INSPECTED?	ABNORMALITY?	EQUIP.	INSPECTED?	ABNORMALITY?
Tower			Electrical/Electronic Equipment		
Enclosure			Cables		

2. Tower Maintenance (if repeater and tower owned by NWS specifically for NERON)

☐ Tower plumb ☐ Guy wire tension checked/adjusted ☐ Safety inspection complete

3. General Maintenance (Enter Y for yes**, O for** no**, or — for** not applicable **in each box)**

CLEANING (REPEATER)	CLEAN ON ARRIVAL	CLEANED
Solar Panel		
Battery Terminals		
Volt Reg Terminals		

☐ Desiccant replaced (16 units every 6 months in repeater enclosures w/o cable glands or one-way air valves)
☐ Wire terminal connections tightened
☐ Replaced all repeater batteries that failed load test

4. Communication System Maintenance

RF POWER	FWD	REF
Arrival		
Departure		

☐ Inspected antenna cable for damage
☐ Inspected antenna cable connectors for corrosion
☐ Inspected antenna for damage
☐ Inspected antenna connector for corrosion

5.
☐ Verified that station radio transmitting and receiving
☐ Verified that the data monitoring and collection facility can communicate with all equipment, if a base station
☐ All holes in repeater enclosure and conduit openings duct sealed
☐ Station departure time recorded at top of form
☐ All enclosures locked, if repeater and not inside locked building

6. Documentation Submitted to ISOS Office

☐ This one-sided maintenance form ☐ Trouble ticket(s), if applicable

NOTES:

CONTRACTOR REPRESENTATIVE NAME	DATE SUBMITTED TO NWS	DATE RECEIVED BY NWS

NERON REMOTE WEATHER STATION MAINTENANCE FORM FOR SITE HOSTS, OBSERVERS, AND WFOs

NOTE: Please submit this electronic form or a paper **ORIGINAL** to the ISOS Office.
(Please use BLACK INK on this form to facilitate scanning.)

STATION ID	UTC DATE ARRIVE	UTC TIME ARRIVE	UTC DATE DEPART	UTC TIME DEPART

MAINTAINER NAME	MAINTAINER TYPE (CIRCLE ALL APPLICABLE)
	SITE HOST OBSERVER WFO

1. Visual Inspection (Note any obstructions removed or abnormalities)

EQUIPMENT	INSPECTED?	ABNORMALITY?	DESCRIPTION
Mast/Tower	Y N	Y N	
Enclosures	Y N	Y N	
Radiation Shields	Y N	Y N	
Sensors	Y N	Y N	
Precipitation Gauge	Y N	Y N	
Cables	Y N	Y N	
Terrain	Y N	Y N	
Vegetation	Y N	Y N	

2. Vegetation Maintenance

☐ Vegetation cut to between 1- and 3-inch height

3. General Maintenance

☐ Cleaned radiation shields
☐ Cleaned solar panel(s) (Except at tall tower sites)
☐ Cleaned pyranometer

4. Precipitation Gauge Maintenance (Performed only by WFOs)

☐ Emptied bucket
☐ Added antifreeze (Winter season only) →
☐ Added 0.5 qt oil

AMOUNT OF ANTIFREEZE ADDED (L)

5. Final Tasks

☐ Station arrival and departure times recorded at top of form
☐ All enclosures locked

Notes:

DATE SUBMITTED TO ISOS OFFICE	DATE RECEIVED BY ISOS OFFICE

Form Date: March 22, 2005

NERON TROUBLE TICKET/SITE VISIT FORM

☐ Site Visit Only

STATION ID	STATION NAME	STATION STATE	STATION TYPE	DATE TRACED TO
			REMO RPTR BASE	

REPORTER	REPORTER AFFILIATION	DATE PROB NOTICED

PRIORITY 4 (10 BUSINESS DAYS)					PRIORITY 6 (20 BUSINESS DAYS)				
TAIR	VWPCP1	BUCKET	VREG	ACTRAN	WSPD	WDIR	WS2M	PRES	SRAD
PRECIP	VWPCP2	RADIO	VREGS	BATCHG	IRTT/IRTH	RELH	DEWPNT	WTRVAP	
LOGG	VWPCP3	RFMODM	SOLRP	FLDOOR	TS005	TS010	TS020	TS051	TS102
BATV	BATVS	RS232IF	SOLRPS		FW005	FW010	FW020	FW051	FW102

PRIORITY 9 (30 BUS. DAYS)								
WIRPAN	MUX	ETHHUB	SERADS	PDA	TPS	TPRECP	TSLO	
PRTMOD	SERSRV	ROUTER	SERADH	UPS	SRGSUP	FLPHTR		

Description of Problem:

_____ Priority: ___Fix Due By: _____

Entered by: _____ Date: _____ Ticket #: _____

UTC DATE ARRIVE	UTC TIME ARRIVE	UTC DATE DEPART	UTC TIME DEPART	MAINT. CONTRACTOR	TECHNICIAN(S)

[OSR] [RPL] [INI] [RMV] [NAT] _____ (OLD SN) _____ (NEW SN)

Description of Fix:

Operator: _____ contacted (for SRAD and SOILMOIST) Time: _____

Entered by: _____ Date: _____

Purpose of Visit: MAINTENANCE COMMS INI T-TKT LIGHTNING THEFT

EQUIP.	INSPECTED?	ABNORMALITY?	EQUIP.	INSPECTED?	ABNORMALITY?	EQUIP.	INSPECTED?	ABNORMALITY?
Mast/Tower			Sensors			Terrain		
Enclosures			PRECIP			Vegetation		
Radn Shields			Cables					

CLEANING	CLEAN ON ARRIVAL	CLEANED	CLEANING/ LEVELING	CLEAN ON ARRIVAL	CLEANED	LEVEL ON ARRIVAL	LEVELED
TAIR Shelter			PRECIP				
RELH Shelter			SRAD				
Solar Panel(s)			IRTT				

RF POWER	FWD	REF
Arrival		
Departure		

☐ Vegetation cut to 3-inch height or less
☐ Desiccant replaced
☐ Emptied precipitation gauge
☐ Added antifreeze (winter season) →
☐ Added 0.5 L (0.5 qt) oil

AMOUNG OF ANTIFREEZE ADDED (L)

PRECIP CAL	PRECIP S/N: SER. NO.	F_o	BUCKET S/N: A	B
VWPCP1				
VWPCP2				
VWPCP3				

Notes:

Form Date: March 22, 2005

NERON TROUBLE TICKET FORM FOR MASS INSTALLS, FIXES, OR MOVES

STATION ID	STATION NAME	STATION STATE	STATION TYPE	UTC DATE ARRIVE	UTC TIME ARRIVE	UTC DATE DEPART	UTC TIME DEPART
			REMO RPTR BASE				

MAINT. CONTRACTOR	TECHNICIAN(S)	ENTERED BY	DATABASE ENTRY DATE

DESCRIPTION OF PROBLEM

Param ID	Old SN	New SN	Description of Fix: (Include OSR, RPL, INI, RMV, NAT)	T-Tkt No.
LOGG				
WIRPAN				
PRTMOD				
MUX				
RADIO				
RFMODM				
RS232IF				
SERSRV				
ETHHUB				
ROUTER				
SERADS				
SERADH				
PDA				
SOLRP				
SOLRPS				
ACTRAN				
UPS				
SRGSUP				
TPS				
VREG				
VREGS				
BATCHG				
BATV				
BATVS				
BATVS				
BATVS				
BATVS				
TAIR				
PRECIP				

NERON TROUBLE-TICKET FORM FOR MASS INSTALLS, FIXES, OR MOVES

Param ID	Old SN	New SN	Description of Fix: (Include OSR, RPL, INI, RMV, NAT)	T-Tkt No.
BUCKET				
VWPCP1				
VWPCP2				
VWPCP3				
WSPD				
WDIR				
WS2M				
WD2M				
PRES				
SRAD				
IRTT, IRTH				
RELH, TSLO				
DEWPNT				
WTRVAP				
FW005, TS005				
FW010, TS010				
FW051, TS051				
FW102, TS102				
TPRECP				
FLPHTR				
FLDOOR				

Form Date: November 11, 2004

GEONOR PRECIPITATION GAUGE CALIBRATION SHEET

STATION ID	DATE	PERFORMED BY	PERFORMER AFFILIATION

GAUGE BASE SERIAL NO.	BUCKET SERIAL NO.

	VIBRATING WIRE 1	VIBRATING WIRE 2	VIBRATING WIRE 3
	SERIAL NO.	SERIAL NO.	SERIAL NO.
WEIGHT (g)	FREQUENCY (Hz)	FREQUENCY (Hz)	FREQUENCY (Hz)
0			
1000			
2000			
3000			
4000			
5000			
6000			
7000			
8000			
9000			
10000			
11000			
12000			
F_o (e^0)			
A (e^{-2})			
B (e^{-6})			

Form Date: March 22, 2005

NERON STATION METADATA FORM

☐ Initial Installation ☐ Move ☐ Update (enter only changed information after first two lines)

STATION ID	STATION NAME	STATION TYPE	UTC DATE EFFECTIVE	UTC TIME EFFECTIVE
		REMO RPTR BASE		

INSTALLER/MAINTAINER	COOP NO.	WBAN NO.

SITE INFORMATION

LATITUDE (DEG, TO 5 DECIMAL PLACES)	LONGITUDE (DEG, TO 5 DECIMAL PLACES)	ELEVATION (FT)	UTC OFFSET (STD TIME)	MAGNETIC DECLINATION

LAT/LON SOURCE	ELEV SOURCE	HORIZ. COORDINATE REF DATUM	VERT. COORDINATE REF DATUM

STATE	COUNTY	CLIMATE DIVISION	WFO CWA ID	GOV'T PROPERTY ID

PLOT SIZE	FENCE INSTALLED?	FENCE TYPE
10x16 16x20 20x40	Y N	

POWER TYPE	LOGGER ENCLOSURE HEATER INSTALLED?	NO. OF GROUND RODS	NO. OF GROUND PLATES	NO. OF MESH GROUND POINTS
SOLAR AC	Y N			

BASIC SENSORS INSTALLED

	MANUFACTURER	MODEL NO.	SERIAL NO.
TAIR			

	MANUFACTURER	MODEL NO.	BASE SERIAL NO.	BUCKET SERIAL NO.
PRECIP				

VWPCP1	VIBRATING WIRE 1 SERIAL NO.	F_o	A	B
VWPCP2	VIBRATING WIRE 2 SERIAL NO.	F_o	A	B
VWPCP3	VIBRATING WIRE 3 SERIAL NO.	F_o	A	B

TYPE OF GAUGE	HEIGHT OF RAIN GAUGE INLET	HEATER INSTALLED?	HEATER MANUFACTURER	HEATER MODEL NO.
WEIGHING TIPPING	in.	Y N		

TYPE OF ANTIFREEZE	TYPE OF OIL	AMOUNT OF ANTIFREEZE ADDED
		L

ENHANCED SENSORS INSTALLED

	MANUFACTURER	MODEL NO.	SERIAL NO.
RELH			
DEWPNT			
WTRVAP			
WS2M			
WSPD			
WDIR			
PRES			
SRAD			

IRTT	MANUFACTURER	MODEL NO.	SERIAL NO.
FW005	MANUFACTURER	MODEL NO.	SERIAL NO.
FW010	MANUFACTURER	MODEL NO.	SERIAL NO.
FW020	MANUFACTURER	MODEL NO.	SERIAL NO.
FW051	MANUFACTURER	MODEL NO.	SERIAL NO.
FW102	MANUFACTURER	MODEL NO.	SERIAL NO.

EQUIPMENT INSTALLED

LOGG	MANUFACTURER	MODEL NO.	SERIAL NO.	
	OS/FIRMWARE VERSION	PROGRAM/SETUP NAME	PROGRAM/SETUP VERSION	PAKBUS ID (CSI ONLY)
WIRPAN	MANUFACTURER	MODEL NO.	SERIAL NO.	
PRTMOD	MANUFACTURER	MODEL NO.	SERIAL NO.	
MUX	MANUFACTURER	MODEL NO.	SERIAL NO.	
RADIO	MANUFACTURER	MODEL NO.	SERIAL NO.	

TYPE LETS	LETS FREQUENCY/BAND (MHz)	LETS RF ID	LETS SUBNET ID	LETS PRIMARY BASE ID	
CDMA	CELL SERVICE PROVIDER	CELL ESN/EIN	CELL MDN	CELL MIN/MSID	
GSM	CELL IP ADDRESS	CELL NETWORK ACCESS ID	CELL SID	CELL NID	CELL FREQUENCY BAND
GOES	GOES NESDIS ID	GOES BAUD 100 300 1200	GOES NESDIS CHANNEL	GOES TXER CHANNEL	
	GOES TX TIME (s)	GOES WINDOW (s)	GOES INTERVAL (s)		

ANTENNA HEIGHT (FT)	ANTENNA TYPE DIPOLE YAGI GOES YAGI OMNI	NO. YAGI ELEMENTS	ANTENNA AZIMUTH	ANTENNA INCLINATION

RFMODM	MANUFACTURER	MODEL NO.	SERIAL NO.	
RS232IF	MANUFACTURER	MODEL NO.	SERIAL NO.	
SERSRV	MANUFACTURER	MODEL NO.	SERIAL NO.	IP ADDRESS
ETHHUB	MANUFACTURER	MODEL NO.	SERIAL NO.	
ROUTER	MANUFACTURER	MODEL NO.	SERIAL NO.	IP ADDRESS
SOLRP	MANUFACTURER	MODEL NO.	SERIAL NO.	INCLINATION
SOLRPS	MANUFACTURER	MODEL NO.	SERIAL NO.	INCLINATION
ACTRAN	MANUFACTURER	MODEL NO.	SERIAL NO.	

UPS	MANUFACTURER	MODEL NO.	SERIAL NO.	
SRGSUP	MANUFACTURER	MODEL NO.	SERIAL NO.	
TPS	MANUFACTURER	MODEL NO.	SERIAL NO.	IP ADDRESS
VREG	MANUFACTURER	MODEL NO.	SERIAL NO.	
VREGS	MANUFACTURER	MODEL NO.	SERIAL NO.	
BATCHG	MANUFACTURER	MODEL NO.	SERIAL NO.	
BATV	MANUFACTURER	MODEL NO.	SERIAL NO.	
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.	
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.	
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.	
BATVS	MANUFACTURER	MODEL NO.	SERIAL NO.	
SERADS	MANUFACTURER	MODEL NO.	SERIAL NO.	
SERADH	MANUFACTURER	MODEL NO.	SERIAL NO.	
PDA	MANUFACTURER	MODEL NO.	SERIAL NO.	

SITE ACCESS

Will NWS and NWS contractors have unrestricted access to the site and be able to work late and on weekends?
☐ Yes ☐ No

LOCKED GATE?	NWS LOCK ALLOWED?	NWS LOCK INSTALLED?	NO. OF KEYS ACQUIRED	KEY NUMBER/ID	LOCK COMBO (IF APPLICABLE)
Y N	Y N	Y N			

If a LETS agency, will identification be required to enter the premises?
☐ Yes ☐ No

List any site access restrictions that will be in place below:

Can 2WD vehicles drive to the site throughout the year? ☐ Yes ☐ No

Can 4WD vehicles drive to the site throughout the year? ☐ Yes ☐ No

If not, for either case, explain below:

Does the site host prefer not to have vehicles driven off-road under certain conditions or have any restrictions on the route that is driven to the site on the host's land? ☐ Yes ☐ No

If so, explain below:

SITE DRIVING DIRECTIONS

(From the intersection of two US/state highways or from an interstate highway exit to the site)

SITE HOST SPECIAL INSTRUCTIONS

How does the host prefer that vegetation cuttings be disposed of?

☐ No preference ☐ Single pile outside plot ☐ Spread evenly outside plot ☐ Bagged and carried away

☐ Other, explain below:

Other special instructions:

SITE CONTACT INFO

CONTACT			
ADDRESS 1			
ADDRESS 2			
CITY		STATE	ZIP
PHONE	FAX	EMAIL	

NOTES

OBSTRUCTIONS

(Use only **BLACK INK** to facilitate scanning)

Draw each obstruction within 330 feet (100 meters) of the center of the plot, label its bearing from the center of the plot in degrees relative to true north, its height in feet, and its distance from the center of the plot in feet below. The center of the circle below indicates the center of the plot and the edge of the circle represents the extent of the 330-foot range.